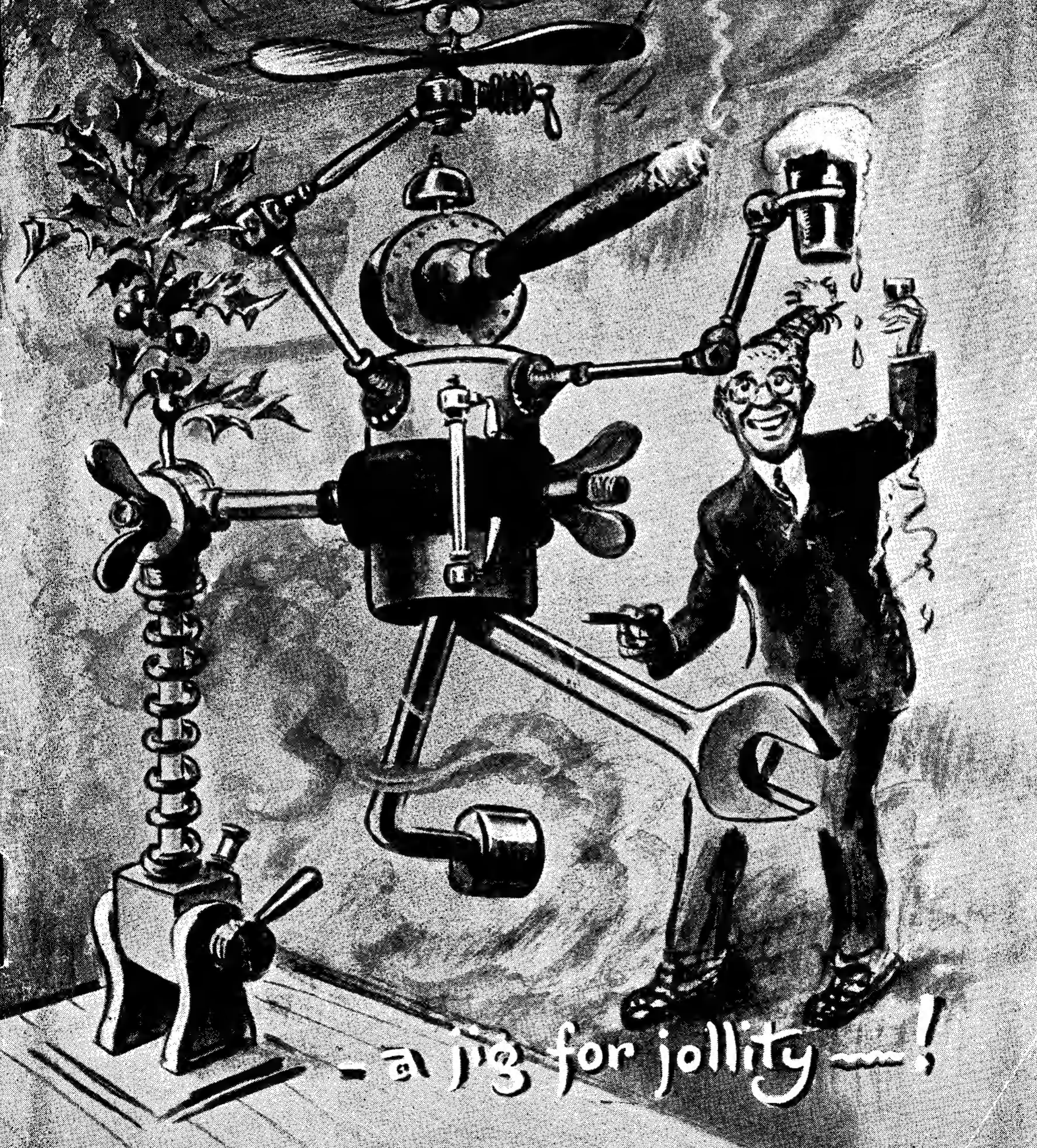
THE MODEL ENGINEER

Vol. 103 No. [illegible] THURSDAY DEC. 21 1950 9d.



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

21ST DECEMBER, 1950 VOL. 103 NO. 2587

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SMOKE RINGS

Our Cover Picture

● WELL, IT is Christmas, the time of year when all good-natured folk are determined that, at all costs, fun and frolic shall be the ruling sentiments, for a day or two at least. The model engineer-artist who concocted the picture [?] from which our cover has been prepared seems to have hit the right nail fairly and squarely on the head; every detail in his gloriously fantastic contraption would seem to possess its own particular significance, and the only question which comes to our mind is: Does it work?

We leave it to our readers to make up their own minds as to what is the right answer; but, with our cordial good wishes to our readers everywhere, we offer this cover in the hope that it will at least raise a smile during the few days when cares and worries can be forgotten. With such a jig at hand, jollity must surely follow!

The Forgetful Secretary

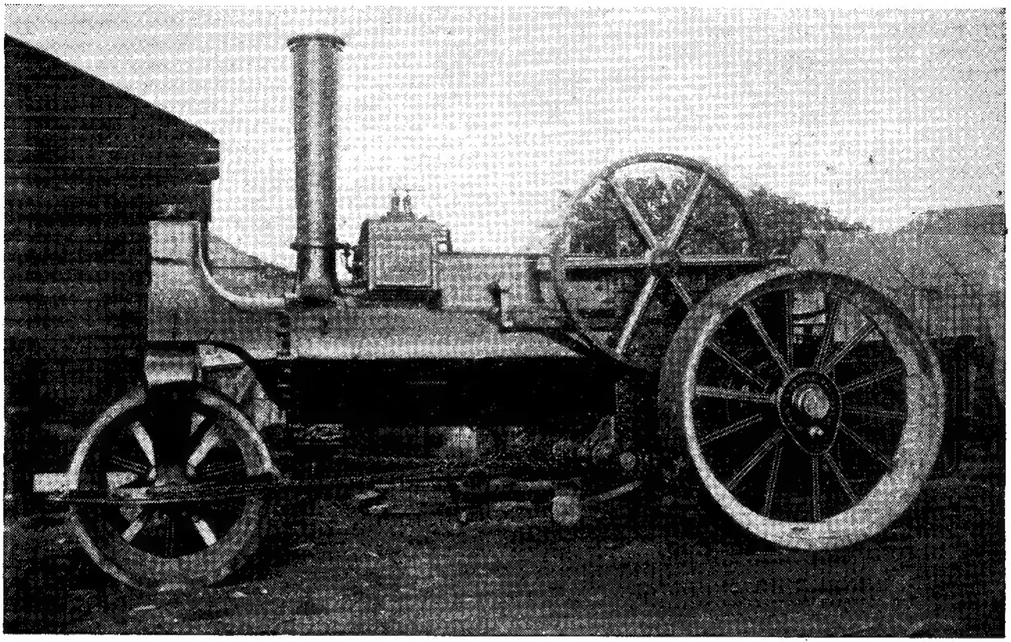
● WE HAVE received a cordial invitation to attend a club function which will have taken place by the time this paragraph has been published. The invitation was in the form of a carbon copy of a typed letter on which, of course, *our* address had been typed, and the sheet had been duly signed by the secretary. Unfortunately, he had omitted to notice that the continuation sheets were just plain paper, and that neither the name and address of his club nor his own address were printed or written on them.

Naturally, we spent some time in searching through our card-index of clubs and societies, but we failed to discover our friend's name among the secretaries. The next step was a determined onslaught upon our waste-paper basket, in the hope of finding the envelope which had contained the invitation; we found three "possibles," on two of which the postmarks were clearly legible, but the third was indecipherable. The first two drew blank in our "identification parade," so there is a strong suspicion that the third was the one we were after; but, since the postmark was illegible, we are still without a clue as to whence it had come.

We have every sympathy with club secretaries, who, after all, are voluntary officers, adopting methods which seem to save time and trouble; but it *can* be overdone, and here we appear to have an instance of it. We have been unable to answer this particular invitation, and there is more than a probability that the sender feels that we are grossly discourteous; but, having regard to all the circumstances, can anyone be surprised if our feelings are reciprocal?

Traction-cum-Roller-cum-Portable

● OUR RECENT publication of a form of tender by Aveling & Porter Ltd. for an 8-h.p. traction engine "adaptable for a steam roller and capable of working a rock-drill as well as driving a stone-breaker" aroused some considerable interest. Our remark that we do not recall having seen an illustration of such an engine has brought us two, one from Mr. George Allen, of London, S.W.17, and the other from Mr. J. A. Smith, of Liversedge, Yorks.



The photograph from Mr. Allen is reproduced on this page, and we quote from his interesting letter: "During 1902, when I was an apprentice in a small country shop in Scotland, we had this engine from the East Stirlingshire C.C. for repairs; these included a new (steel) firebox, so that it was probably built at least 20 to 30 years before the one mentioned.

"About the time the job was finished and repainted, I had made a camera of sorts from scrapped bits and pieces acquired, by persuasive negotiation, from several friends. The 'shutter' was a pill-box (scrounged from the local chemist) necessitating a slow plate and a small stop, which makes the ugly background rather obtrusive.

"The traction front wheels did not come to the shop, but the pin for their attachment can just be seen under the smokebox."

As can be seen, the engine is simple, neat and straightforward in design, characteristic of Aveling & Porter practice. And we would add our congratulations to Mr. Allen upon the result obtained, all those years ago, from his home-made camera; the print is in a very good state of preservation, too.

A Possible M.E.T.A. Development

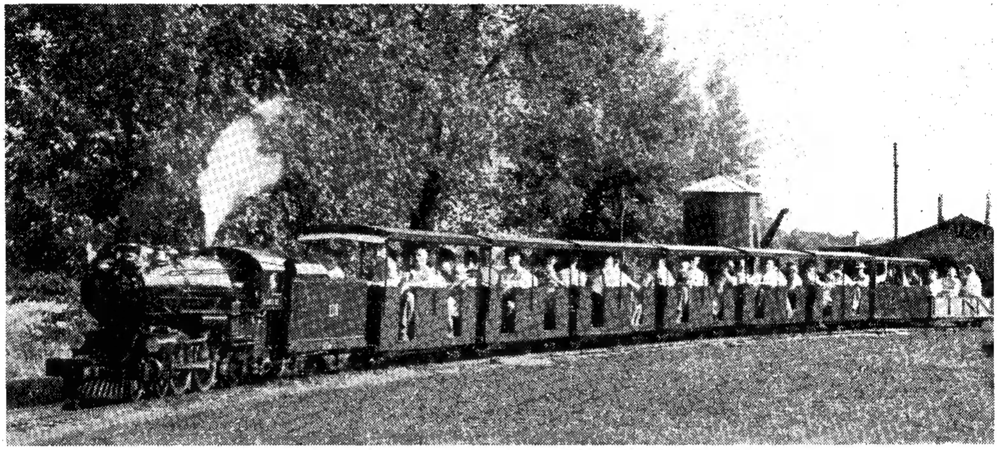
● THE MODEL Engineering Trade Association, which represents the principal producers and distributors of model engineering equipment, is a body that has steadily grown in importance and influence during the past seven or eight years, and unobtrusively has done a considerable amount of good work in the interests of the trade. In order to further its aims and objects and to foster a better and more widespread understanding of its activities, the Association has under consideration a scheme for creating some measure of public membership. The effect of this would be to achieve a closer contact between the Association and the model-making public, and this would result in providing a means of direct approach between manufacturers and dealers on the one side and their customers on the other.

Any readers interested in this scheme should send their names and addresses to the Secretary, the Model Engineering Trade Association, 156, Camden High Street, London, N.W.1; if the scheme materialises, a purely nominal subscription would be charged for public membership. In return, members would receive copies of the M.E.T.A. bulletin four times annually, and other literature issued from time to time; be able to vote in two competitions to be organised, and to attend such lectures and rallies as may be arranged. The scheme would give first-class opportunities for members of the public to present their modelling needs and views direct to the model engineering trade, and the members of the Association cordially invite the co-operation of any model engineer interested.

Christmas Greetings—

from "L.B.S.C."

IF the railways and other forms of transport are all running normally, and our good friends the printers don't decide to take an unexpected holiday, you will probably be reading these notes on the Thursday or Friday before Christmas; so I would like to snatch the opportunity of conveying heartfelt and sincere Christmas greetings to one and all. It may sound strange, but it is an absolute fact, that whilst I am never at a loss for words to explain how to build locomotives, and describe the various processes entailed, and can even write a short story for your amusement, yet when it comes to putting my *feelings* into words, I am just absolutely and completely sunk. Practically from the time these notes first made their appearance over 26 years ago, the fortnight before Christmas has seen a cascade of letters and cards descending on our doormat in an ever-increasing flood of greetings. Even through the war years there was quite a considerable flow. Everyone of them has been eagerly read and appreciated; and the sentiments expressed have stirred me to a depth which only those few good folk who know me personally, could fully understand. I'd just love to reply to everyone individually, and direct, but that is a physical impossibility now, for obvious reasons. In a collective reply, the old stereotyped greeting of "Merry Christmas and Happy New Year" is most hopelessly inadequate; but as stated above, I just can't set down in cold print, exactly what I feel, so please "take it as read" that you all have a warm corner in a heart which is old in years, but has simply refused to "grow up." I guess you'll understand!



A hefty load for a Sandley engine on the 15 in. gauge Riverside & Great Northern Light Railway, at Janesville, Wis., U.S.A. Details of the locomotive will appear later

Maybe, as I roll on toward the terminal station of the Great Railroad of Life, I'm getting a bit pernickety, in a manner of speaking; but the above-mentioned "Merry Christmas and Happy New Year" seems to sound rather hollow nowadays; when I was a child, the meaning seemed literal. The first Christmas of which I have distinct recollection, was in the early eighties of the last century, when I was but four years of age. Mother and granny went out on the Christmas eve, to do a little shopping; not much, as we were very poor. I went with them, and I remember how gay the High Street looked, with all the shops decorated up, and well stocked with good things. There were crowds of people, too, all cheerful and smiling. Many of the street tramway cars, small four-wheeled vehicles, were drawn by three mules running abreast; and one old red-faced white-bearded driver, who bore a striking resemblance to the legendary Santa Claus, decorated up the mules' harness with sprigs of holly and mistletoe, tied a small bell to each of their collars, and put on a red hat. There was great delight and much "hooraying" from the kiddies as the tramway-car rattled along the High Street, to the clattering of the mules' hooves and the jingling of the bells; in the kiddies' estimation, it was the next best thing to seeing the real Santa and his reindeer-hauled sleigh. The day was frosty, though the sun was bright, and there was a keen wind. I was wearing a wool coat, and a wool tam-o'-shanter which I had pulled down over my ears, to prevent them being "nipped"; and granny bought me a pair of woollen gloves for a Christmas box, to save me from chilblains on my fingers. Mother bought me a big bag of sweets for a penny, and I was supremely happy, without a care in the wide world.

Incidentally, vivid memories of that Christmas eve came back to me on the same day in 1940, when "civilisation" had progressed to such an extent, that everybody was "happy and cheerful" in the knowledge that ere Christmas morning dawned, their homes might be reduced to heaps of rubble, and they themselves blasted into eternity. Who was it wrote that: "Man's inhumanity to man makes countless thousands mourn?" Nuff sed!

Young Curly voted mother's Christmas pudding a great success; and the cup of joy ran over on the evening of Boxing Day, when the kiddies from two doors away, came and asked mother if I might join their party. I was very shy, but their "mum" made me very welcome; and when it was over, she gave me a hearty kiss and sent me home with a small present. Happy days of childhood!

Looking Backwards

Correspondents often ask why I have not written any childhood or other reminiscences for a long time now, and ask for more tales of young Curly. Well, if I tell you the honest truth, it is because thoughts of happy and carefree days long since past, make me very sad, when I compare them with the times we are now living in. Atom bombs, air-raid shelters, civil defence, and so on—it's too much for an old-fashioned peace-loving fogey like me. Wouldn't this be a grand old world if everybody cast aside all thoughts of bloodshed and destruction, and concentrated on making it the finest possible place to live in? The irony of it is, *it could be so*! Just fancy what a lot of lion-and-wheel brand engines, carriages, and wagons could be built; how many houses could be put up, and how many new roads and railways made, for a fraction of the money now being spent in the armament race! However, these columns are no place to preach sermons, so please forgive old Curly's passing thoughts, and let's see what we can do to please the above-mentioned correspondents.

I have already related many childhood anecdotes, and also recorded some of the things that happened when I worked on the railway; and some events have faded with the passing of the years. However, in a journal which somebody sent me a short while ago, there was a mention of the Loco Spotters' Club; and although the existence of this is of fairly recent date, the art of "locomotive spotting" is nearly as old as the engines themselves. In the old days of the London Brighton and South Coast Railway, when every engine, except the class "C" tender engines, bore a name, there was keen competition among the children living in the suburban area, to compile a complete list of the names and numbers, with shed letters and drivers' names as "accessories." Young Curly was a very ardent fan; and I had two advantages. One was an excellent memory; I have already told how I swotted up school lessons, to get them over and done with, and was in the top class at eleven years of age, besides scooping the prize for highest proficiency. The old school master used to hold me up as a shining example to backward and lazy pupils, and didn't suspect that the nefarious purpose behind all my assiduousness, was merely to enable me to spend more time building my toy engines, or haunting the tracks of my dearly-loved L.B. & S.C.Ry! Anyway, I could remember engine numbers, names, classes and sheds, just as easily as I could remember school lessons; and although I kept a book, I knew the details of the engines without having to consult it. Even now, I can recollect the names and numbers of all the Brighton engines that were on the road at the turn of the century.

The second advantage, was my wanderlust. I believe I stated that mother put no restriction whatever on my coming and going. There were two conditions; I had to promise faithfully to keep out of trouble, and tell her when I would be home. I never betrayed her trust. A neighbour who kept her children "on rein," once criticised this policy; and all mother replied, was that if I announced my intention of going to Australia, she would put my few belongings in a parcel, and kiss me good-bye, in the sure knowledge that if alive and well, I would come back to her on the day promised. Consequently, most Saturdays found me on my way, bright and early. If I had earned a few coppers, I would buy a half-ticket to any point on the line, for which cheap fares were available—and they *were* cheap in those days; for the modest sum of one shilling and sixpence, I could get a trip from London Bridge to Brighton and back—but if funds were low, it was a case of walk out and ride back, or in emergency, walk both ways.

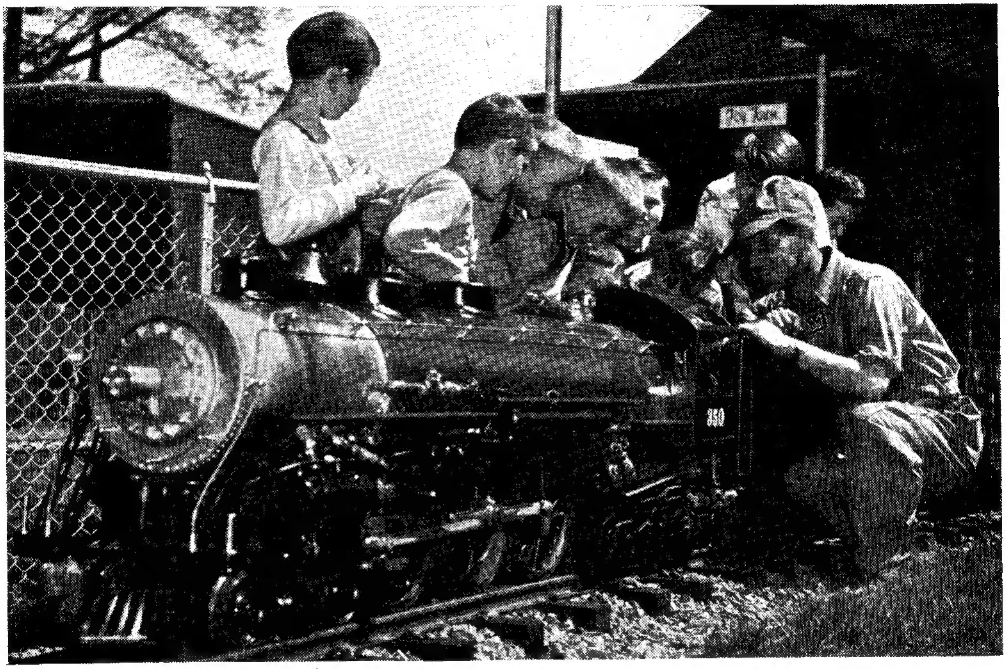
I had several regular haunts in the second category, the principal of which was Tooting Common, through which the main line from Victoria, and the suburban line to Crystal Palace both ran, the diverging point being Balham Junction, close to the station at Balham. Tooting Common was a regular venue for locomotive name-and-number hunters; and as most children easily make friends, I soon became well acquainted with some kindred spirits, although they always made the first advance, as I was naturally shy. Incidentally, owing to my treble voice and long curls, I was always known as "that gal," despite the fact that I wore a sailor blouse and knickers!

Whys and Wherefores

At that time, the fence opposite Balham Intermediate signal-box (between Balham Junction and Streatham Junction North signal-boxes) was a low wooden one with a wide top rail, on which a child could sit quite comfortably, and fairly close to the trains; and this was our favourite point of vantage. We made friends with all the signalmen who took turns of duty, also with the porters from Balham who used to come down to clean and light the signal lamps. Many of the signals had gas burners in them, in those days, as there were, of course, no electric signals, and no long-burning oil lamps. In passing, these were looked on with disfavour by the railwaymen when they first appeared, as being a retrograde step after using gas. One thing that tickled the children immensely, was the fog repeaters. These were wee signals about two feet high, with arms to correspond, which stood close to the bottom of each full-sized signal, and worked in unison with it. Many heated arguments took

place as to what they were used for, until a friendly platelayer heard the children talking one day, and explained. It so happened that he was one of the lengthmen detailed for fogging duty, and had some fog-signals in his bag; and great was the excitement when he placed one on the rail and gave it a wallop with his long-handled hammer, One kid said he would like a few of them for Guy Fawkes Day!

above, evidently knew his geography all right, for he remarked. "Coo! *Rhine* is a river, and they don't make engines in the water, like ships, an' if it 'ad been made in some town on the river, crikey, they wouldn't 'ave called it *Rhine*, would they?" This led to another lively debate, and the meeting was finally adjourned until the following Saturday, when matters were further complicated by the appearance of 145 *France* and



Engineer John Gardner explains the mysteries of a Lester Friend engine to an admiring audience. Young Curly would have loved this!

The whys and wherefores of the names borne by the engines, was another frequent subject for debate among the children. Kiddies were ever quaint, and get hold of some weird and wonderful ideas. I know, personally, that I "lived in a land of my own," in a manner of speaking, and loved to "daydream"—in fact I still do, and am not ashamed to own it. One boy persistently argued that when an engine bore the name *Bermondsey*, *Brockley*, *Anerley*, and so on, it was either to denote the place where the engine was built, or where it was stabled. Most of the kiddies called the sheds either engine-houses or stables. This theory found a good deal of favour, and it was thought that the goods engines named *Cannes*, *Geneva*, and *Bologna* were built abroad, because, as one bright youngster said "P'raps they ain't got enough stuff to make all the lot 'ere." This was another accepted doctrine, especially as the goods engines were painted a different colour, olive green instead of yellow. However, that theory was promptly exploded when one afternoon a goods train ambled by, going towards Balham, and hauled by engine No 88, *Rhine*! The propagandist mentioned 150 *Adriatic*. The theorist-in-chief, whose name was Charlie, confessed himself stumped.

A Clue

However, the kiddies had brains, and used them. Matters remained at a deadlock for two or three weeks, and then somebody had a brain-wave. No. 188 *Allen Sarle* went by. Charlie said: "It says, 'Allen Sarle, Secretary and General Manager' at the bottom o' them big timetables outside Balham Station. P'raps that's why they put it on the engine as well." This reasoning stirred up some grey matter in small heads. Later the same afternoon, *Stephenson* came by. Naturally every kid interested in railway engines, knew of the immortal "Geordie," and that clinched the matter; they realised that all the engines bearing names like that must have been "called after some big nob or other" as one of them remarked. Still, this didn't settle the question of the place names, until Charlie eventually said, "I know! They give 'em names, same as our mums gives us names, but it wouldn't 'arf look soppy if they called 'em Charlie, and Bert, an' Jim, so they 'as to find

proper engine names!" This was carried unanimously, and so the great debate was finally settled to everybody's satisfaction. "That gal" never took part in any of the arguments, being rather shy, but sat on the fence and "took it all in"; I can picture the scene and hear the voices now, though it is a flashback of over sixty years. It is said that vivid recollections of childhood happenings occur towards the "end of the road;" that is as maybe—I wouldn't like to say.

The White Lever

I mentioned in a previous reminiscence, that I had made a small replica of an engineman's tommy-bag, and adorned it with a uniform button bearing the initials L.B. & S.C.R. I always carried it on my wanderings, and used it for the same purpose as the enginemen used theirs; its usual contents, when I set forth in the early morning, were bread and cheese, or a couple of meat sandwiches, maybe one or two tomatoes, and an apple, orange, dates, or what-have-you, plus a bottle of well-sweetened cold tea. I can assure you it was like Mother Hubbard's cupboard when I finally reached home! The "spotters" naturally spotted the bag as well, recognised the shape and the button, and naturally jumped to the conclusion that the "gal's" father was a driver; I never undeceived them, for I never knew exactly what my father's profession really was, as I saw so very little of him, and he practically ignored my existence. Anyway, the possession of the bag, and the fact that I was familiar with the names, numbers, and other details of the engines, without having to consult a notebook, gave me some sort of a status in the eyes of the name-and-number fraternity.

I mentioned above, that the kiddies used their brains, and also were keen to find out all about the signals. Sitting on the fence opposite the signal-box, they had observed that when the signalman pulled a red-painted lever, the arm of a square-ended stop signal dropped; but when he pulled a green one, it worked a signal right down the line, the arm of which had a notch in it. They soon found out that the trains only stopped at a square-ended signal at danger, and that the notched ones only indicated the position of the square-ended ones. They called the notched arms "swallow-tails." They also learned the meanings of the bell signals by taking note of what the signalman did when the bell rang, and knew that "ting-ting" meant trains going one way, and "tong-tong" for trains going the other way. At that time, signals only were operated from Balham Intermediate box; there were four tracks, two "downs" together, and two "ups" together; and there were no points in the section at all. The outer down line went over the flying junction bridge at Streatham Common, and joined the line from London Bridge at Streatham Junction South; the inner down line went under the bridge, and on through Streatham Common Station, the up lines, of course, corresponding. Thus there were no blue or black levers in the box, only an array of red and green ones; but slap in the middle of the row was a white one, and that interloper puzzled the kiddies no end. There it stood, all on its own, like a seagull in a flock of crows; and the signalman never touched it. What on earth could it be used for? They puzzled their brains, argued, conjectured, and advanced all sorts of theories, but could come to no conclusion Finally one of them said "Let's ask that gal."

Some time previously, when watching trains from another favourite haunt, the railway bank overlooking the triangular junction at Tulse Hill, I had performed a small service for the signalman at the West Norwood end of the triangle, and had been up in the signal box. He had explained to me what the colours of the levers meant; red for stop signals, green for distant signals, black and blue for points and locking bars, etc., and added that sometimes there were one or two levers on a frame that were not connected, just spares that could be easily connected up if an emergency arose. Whilst not in use, these levers were painted white. Therefore when one of the children came and asked if I could tell them what the white lever was for, I was able to reply that it was just a spare lever, and wasn't used for anything at all. Such "profound knowledge" impressed the kids no end, much to my amusement, and after that, they couldn't have treated me with greater respect if my father had been the general manager! It was a curious thing, but although I became acquainted with many of the children, not one of them ever asked my name. In the street where I lived, I was always just Curly, and at school it was Dolly, on account of my doll-like mop of flaxen curls.

Well, I guess that is enough for the time being, about the Victorian anticipators of the Loco Spotters' Club. Things are vastly different now; the old signals have gone, and green electric trains have replaced the old ones with the yellow engines. Nevertheless, when I cross Tooting Common on the gasoline cart, I'm often sorely tempted to park it by the railway bridge, go down tot he old spot, and imagine for a few moments that I am a happy carefree kid once more, living in a world of peace and friendship, not only at Christmas, but for all time.

Model Bolts and Nuts

We have examined some samples of $\frac{1}{8}$-in. hexagon steel bolts and nuts submitted to us by Mr. R. G. Harris, of The Cottage, Corngreaves Hall, Cradley Heath, Staffs. These appear to be accurately made and well finished, and prices quoted are reasonable for goods of this quality. Mr. Harris also informs us that he has produced baseplate castings for the miniature power-driven hacksaw machine recently described in the pages of THE MODEL ENGINEER by "Duplex."

Rail Circuit Practice

by R. H. Warring

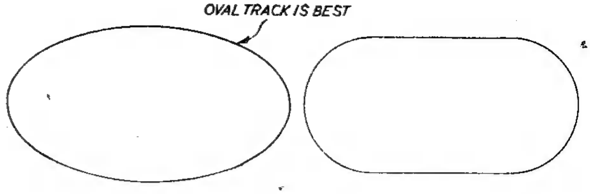


Fig. 1

THE preferred size for a rail track is $\frac{1}{16}$th of a mile, with a corresponding track circumference of 330 ft. Another practical size is the smaller 1/20th of a mile track with a circumference of 264 ft., both tracks having a width of approximately 4 ft., allowing four sets of rails and permitting four cars to be operated at one time. An oval or elliptical plan layout seems to be best. Corresponding banking angles for the 1/16th of a mile track, based on calculation and practical experience, are then 86 deg. for the ends and 20 deg. for the sides. The track with two straights and semi-circular ends is generally considered unsatisfactory, as it is impossible to blend the end banking smoothly, and there is a considerable amount of whip when cars run off the straight into the curves. Mathematically the circular

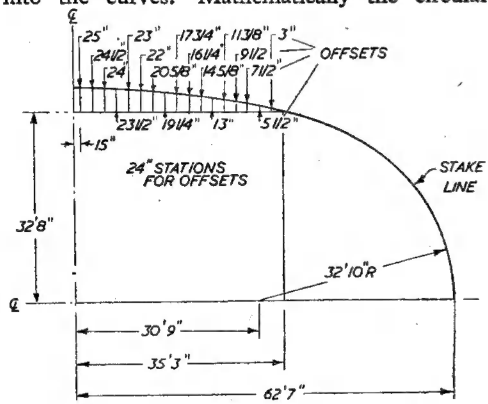


Fig. 2

track is most suitable, but far less attractive in operation.

The layout plan of an oval track can be simplified by making the extreme ends of definite radius and from thence plotting the centre runs by ordinates. An elliptic shape is more difficult to lay out accurately. A typical foundation plan for a $\frac{1}{16}$th of a mile track is given in Fig. 2, based on drawing out two centre-lines at right-angles and constructing a basic rectangle around these. Offsets from this rectangle give the stake line position for marking-out the track, the end radius being 32 ft. 10 in.

For the foundations, railway sleepers have proved both practical and economic, laid end to end around the circumference. Two rows are required, set 26 in. apart. The sleepers are partially buried in crushed stone, leaving some two to three inches projecting above the surface (Fig. 3.) The framework or jacks which attach to these sleepers consist of triangular frames screwed or bolted together from four by two in. material. These, of course, will vary in size and shape depending on their location. The centre jacks have a banking angle of 20 deg., the extreme end jacks 86 deg. (nearly vertical), Fig. 4. For best results, too, they should be aligned perpendicularly to the track. End jacks will therefore, be normal to the describing arc, whilst those over the centre portion require an offset angle, as detailed in Fig. 5. All told, for the $\frac{1}{16}$th of a mile track, 167 jacks are required, set 24 in. between centres.

Now determination of the variation in banking angle between the centres and ends is something

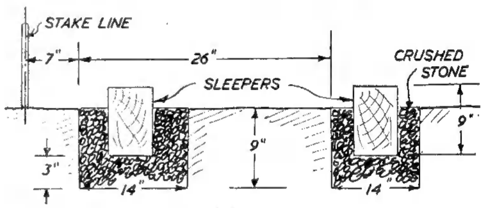


Fig. 3

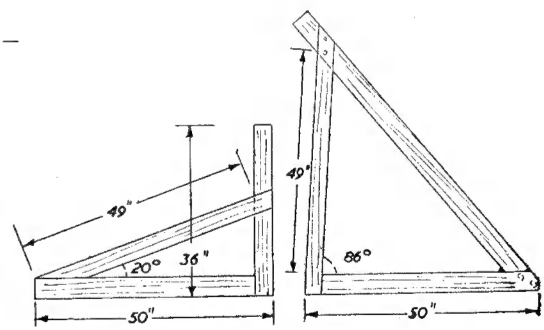


Fig. 4

of a problem. This can be solved mathematically and the jack patterns drawn out accordingly, but equally good results appear to have been obtained by eye alone. All jacks around the end turns will require the same angle—86 deg. With 24 in. spacing, this will account for ninety

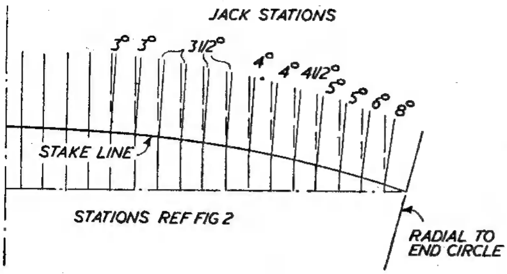


Fig. 5

of the 167 total. Twenty-one jacks are made up to 20 deg., these being spaced on either side of the centre (vertical) line (the odd jack is used to reinforce the roller position). The remaining fifty-six are made up four of a kind, each one progressively increasing from 20 deg. to 86 deg. These can be plotted or "guesstimated." There being fourteen different kinds with a sixty-six deg. variation between the extreme ends, a fair approximation is a five deg. change on each successive jack from the end of the 20 deg.

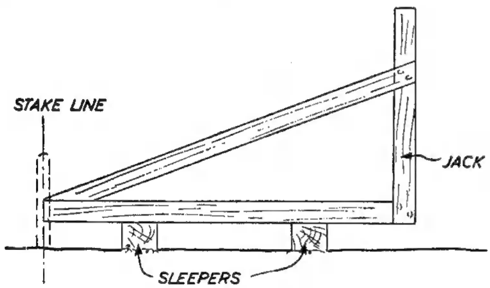


Fig. 6

stretch to the beginning of the 86 deg. end banking.

When all the jacks have been built, they are set up over the sleeper foundations, screwing or nailing directly into the sleepers or attached by straps. They can then be sighted by eye and any necessary adjustments made (Fig. 6).

The next stage consists of laying the running surface over the jacks.

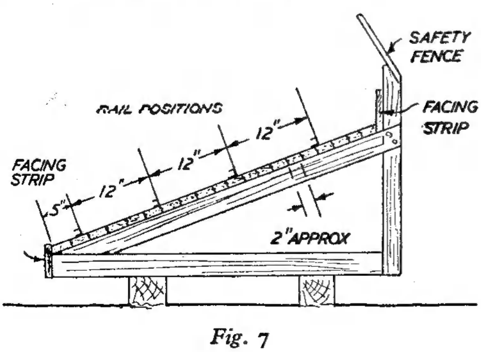


Fig. 7

One 1 in. thick tongued and grooved board is used for this, approximately 1,500 board feet being required to complete the job. Tongued and grooved material is considered essential to hold each board in alignment and eliminate high and low spots. The width of the tongue and groove material must not be too big, otherwise it will be impossible to bend the board to the shape of the curves, a recommended size is 2 in. The boarding is applied direct to the jacks with nails—a job which de-

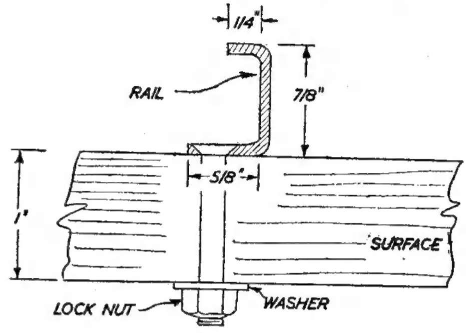


Fig. 8

mands a considerable amount of carpentering skill to obtain a satisfactory result.

A facing strip, approximately four by one in., is now added to the outer edge of the running surface, nailed to the jacks. To, and projecting above, this, is attached a screen of wire netting to form a safety fence. Overall height of this is generally restricted to about eighteen in. although it is usual to slope it inwards at an angle of some 45 deg. to the vertical. Fig. 7 shows a typical section through the finished track.

Rails are cut from stainless-steel sheet $\frac{1}{16}$ in. thick, approximately 1,400 ft. being required for the four sets. Rails are formed by first

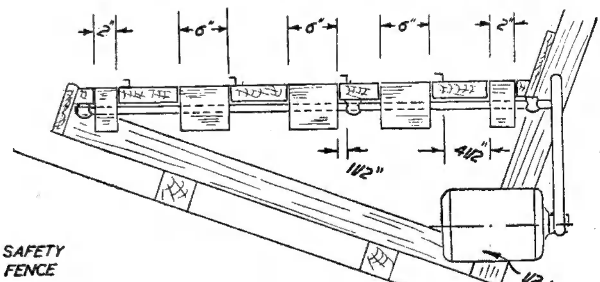


Fig. 9

shearing the sheets into strips $1\frac{3}{4}$ in. wide and then formed to channel section $\frac{7}{8}$ in. high with a $\frac{1}{4}$ in. wide top flange. Bend radii should be as small as possible, consistent with the material being used. (Fig. 8.) Attachment bolts are countersunk, spaced at six to eight in. and secured under the surface boarding with a lock-nut or locking washer. Individual rails are made up in eight to ten feet lengths. About $\frac{1}{16}$ in. clearance is left between adjoining rails to allow

expansion, and the joints must be correctly aligned.

The use of stainless-steel for rails will eliminate corrosion, but other steels can be used. The main objection here is the formation of dirt and scale during the subsequent operation. All the woodwork should be suitably treated to make it weather resistant.

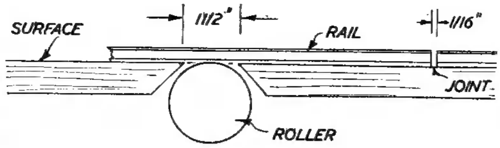


Fig. 10

The final detail remaining is the starting roller, shown in Fig. 9. Five rollers are required three 6 in. wide and two 2 in. wide, all of identical diameter—four to five in. These are mounted on a suitable shaft fitted with a pulley at the outer end connected to an electric motor by means of a V-belt drive. Considerable power will be needed to start four cars at once on the rollers and the minimum size of motor suitable is 1/3 h.p. A ½ h.p. motor would be a better proposition. With a normal motor r.p.m. of between 1,750 and 2,000 a 3 or 4 : 1 reduction ratio between motor and roller pulley is required.

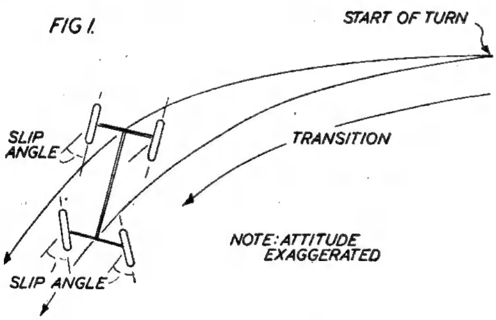
It goes almost without saying that the rollers must not project above the running surface. A 1½ in. gap in the running surface is sufficient (Fig. 10) with the top of the roller coming exactly level with the surface. There is no point in making the opening larger than is necessary. The roller position is then backed up by the odd 20 deg. jack to give it stability.

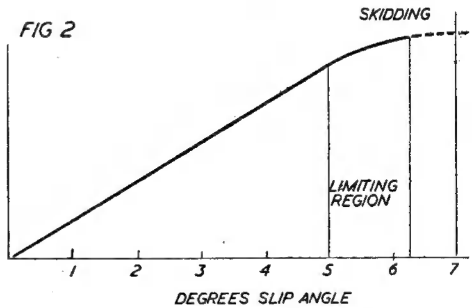
The cost of such a rail track is, of necessity, high, but the erection is permanent and durable. By co-operation and combined effort, the overall cost can be reduced virtually to material costs.

TRACKING PROBLEMS

by A. M. Colbridge

IT is not commonly appreciated that the ordinary free-running car—model or full scale —in following a circular path is not aligned tangential to the circle, but is actually nosed inwards towards the centre. The rear of the car is thus describing a circle of greater radius than the front of the car—Fig. 1. The wheels are now all toed-inwards with respect to the actual path of the car at some small angle known as the slip angle. On the diagram the slip angles have been exaggerated for clarity.





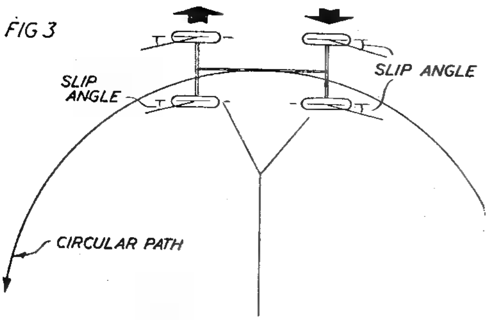
The greater the cornering force to be countered, i.e. the greater the cornering speed and/or the smaller the radius of turn, the greater the slip angle required to balance. In full scale practice the limit is reached at about 6 to 7 deg., after which the tyres begin to skid. This limiting angle, of course, will depend largely on the state of the tyres and the condition of the road surface. The relationship between slip force and slip angle is shown diagrammatically in Fig. 2.

It is fairly safe to assume that a model car can tolerate no greater maximum slip angle than that of a full-scale car, and most probably much less. Tethered, of course, the problem of instability such as skidding does not necessarily arise, but an exaggerated slip angle resulting in skidding can only be wasteful. In the case of the front wheels tracking at an excessive slip angle, and therefore skidding, their resistance to traction will be greater. In the case of skidding rear wheels, power will be wasted. The actual alignment of the model car both to the tether and its circular course would, therefore, appear to be of considerable importance where maximum performance is required. Some possible arrangements are investigated in Fig. 3 *et. seq.*

The attempt to analyse the stability of different arrangements is purely theoretical and should, therefore, be most interesting to compare with practical findings.

The simplest case (Fig. 3) is that of the tethered car running tangential to the circle with both front and rear wheels parallel with the longitudinal axis of the car. Slip angles will be reversed on front and rear wheels which is basically an unstable arrangement, but the angles involved are so small that such instability is

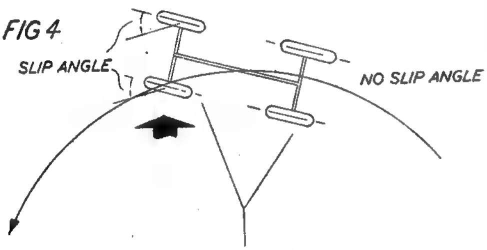
FIG 3



likely to be negligible. Where the radius of circle is small enough to bring these up to the order of one or two degrees some tendency for the rear of the car to swing inwards might be apparent. Re-adjusting the tether to nose the car out slightly in such cases so that the rear wheels are running truly tangential to the circle will increase the slip angle of the front wheels and the stabilising side load (Fig. 4.)

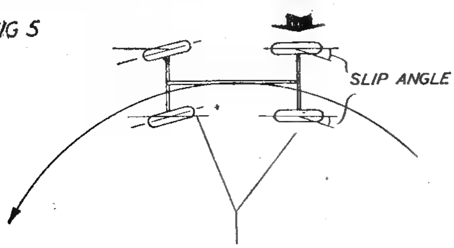
Setting the front wheels inwards at [redacted] slight steering angle [redacted] in Fig. 5 can eliminate the loading on these wheels when they line up tangentially to the rolling circle. Increasing the steering angle still more will introduce [redacted] slip angle again and [redacted] reversed loading directed towards the

FIG 4



centre of the circle. With the rear wheels tracking parallel with the rolling circle the arrangement should border on instability, tending to slacken off the line. Nosing out the car to give zero slip angle on the rear wheels and adjusting the steering angle for similar no-slip angle should result in [redacted] very efficient arrangement with neutral stability. Should the car be displaced inwards, invariably the rear will tend to accelerate outwards to take up a natural "free turning" attitude with slip angles on all wheels—more nosed-in than the original tethered position.

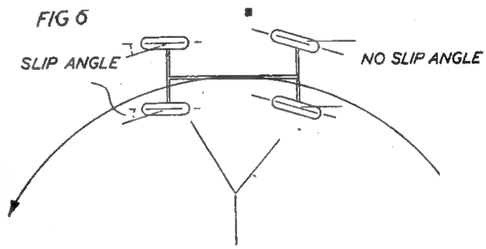
FIG 5



Leaving the front wheels parallel with the body axis and giving the rear wheels [redacted] small steering angle sufficient to produce a slip angle (Fig. 6) will result in the rear of the car tending to accelerate outwards all the time. Provided the front wheels also have [redacted] small slip angle, the arrangement should be quite stable (although not necessarily efficient) as long as the tether line remains taut. On [redacted] slack line, i.e. in [redacted] free-turning circle, once the slip angle on the rear wheels exceeds the skidding value, a catastrophic skid sets in with the rear becoming uncontrollable. Rear wheel steering of any sort is admittedly unstable on [redacted] free-running car and would appear equally undesirable on a tethered model.

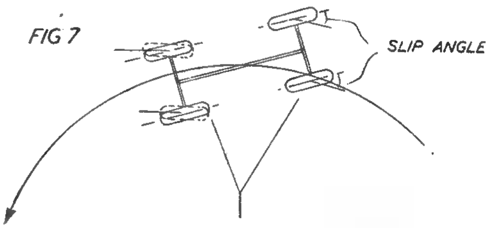
Another possibility is the "natural" or free

FIG 6



turning attitude (Fig. 7). Here the car is tethered nose-in. All wheels now have a slip angle if parallel with the longitudinal axis of the car. Giving the front wheels sufficient steering angle to produce a slip angle in the opposite direction now appears to produce [redacted] most stable layout. This stability is maintained, but reduced, as the front wheel slip angle is reduced. The skid angle of the rear wheels needs only to be small and could probably be tolerated. The arrangement is one tending to nose the car out should the line slacken.

FIG 7

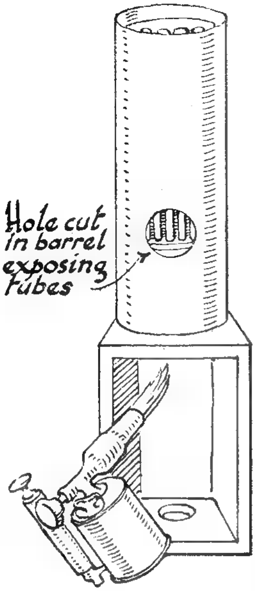


It would be particularly interesting to find whether or not maximum performance is realised with the rear or driving wheels operating at no-skid angle. If so, which of the possible tethering positions is both stable and satisfactory? What skidding angle can be tolerated on the front or steering wheels before inefficiency, or even instability sets in?

Theoretically, maximum performance should come when the car is adjusted with no side loads [redacted] the wheels, so that the whole of the tractive effort is directed tangentially to the rolling circle. Stability of such arrangements, however, is generally marginal.

Tales of a Tyro

by Edward Adams



THE late Harry Tate in one of his music hall sketches, used to refer to an amateur mechanic as an "Engine-very near," and as there are degrees of nearness, so tyros may be of many grades of ability as engineers.

Odd, when you think of it, that I can quite successfully make a complicated piece of mechanism like a locomotive engine and then slip up badly with the boiler.

Perhaps the comparative simplicity of boiler-smithing deceives one into a state of relaxed vigilance, and only when the almost inaccessible leak manifests itself does one realise that more care should have been exercised with the preparatory cleaning and brazing.

At this point the gentle reader may well say "But surely 'L.B.S.C.' and others, have explained every aspect of the work, many times, step by step, and there can be no possible excuse for failure."

Quite true, I am reproved, and yet the fact remains that my adventures with small locomotive boilers would fill a volume, or so my wife says, who has had, perforce, to listen to the tales of woe.

Having made, remade and repaired several small boilers, locomotive and other, an account of some of my struggles may be of interest to other performers with the blowlamp and even disclose what should be avoided.

Most builders would agree that the ideal boiler, apart from its design, is one in which all joints are welded, brazed, or hard-soldered, with the minimum use of soft-solder, except in sealing rivet heads and other precautionary or repair measures, and to be sure that every joint is perfect, particularly in the firebox and combustion chamber.

In my opinion it is well worth the time and trouble of testing this unit before insertion in the outer shell and wrapper, by temporarily sealing the firebox and tubes, pumping in air and immersing in the domestic bath, when any tiny leaks can be seen and easily dealt with. This method has been advocated by "L.B.S.C.", I believe, and I can heartily commend it out of my own experience. I only wish I had always carried it out; the three or four boilers on which this care has been exercised have given no more trouble.

A locomotive boiler seems to be so locked together with stays and tubes as to make internal repairs difficult to do, and on more than one occasion I have had to admit defeat in dealing with leaks, and remake a boiler all over again.

Of all the harassing boiler jobs I have encountered, stopping a leak in a combustion chamber tube plate was, I think, the most tricky.

This was located by plugging the tubes at the smokebox end with soft wood plugs or corks, up-ending the boiler, filling the tubes and combustion chamber with water to just above the tube plate and pumping air into the boiler.

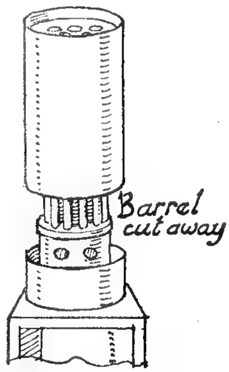
Light—sun or electric—was reflected by a small piece of mirror down the chamber and a peep through the fire door showed the stream of bubbles, unless the actual leak is obscured by the water tubes; even then, one can get a fair idea as to location.

As an alternative to the mirror, a battery pea lamp on the end of about 8 in. of $\frac{1}{8}$-in. tube can be used for this and many other jobs in awkward places.

The boiler having been much in use, it was thought to be impossible to properly clean the metal inside the chamber.

A hole about $1\frac{1}{8}$ in. diameter was, therefore, cut in the boiler shell opposite the offending tube end, and the tubes well cleaned with a small scratch brush and Baker's Fluid. The scratch brush was made by squeezing about a dozen strands of fine steel wire, such as are used in Bowden cable into the end of an odd piece of $\frac{3}{16}$-in. copper tubing, letting the ends project about $\frac{1}{2}$ in.

The boiler was heated by playing a blowlamp into the firebox, and tinman's solder applied through the hole in the barrel, as shown in the sketch.



A test was made by covering the hole with a thick piece of india-rubber, held in place by string binding and pumping in air, bush holes being closed by plugs. Finally, the hole was sealed by a copper plate screwed to the barrel by ten 4-B.A. brass countersunk screws and sweated with soft solder; with the mental resolve never again to run short of water.

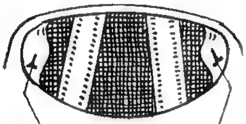
A previous repair job for the same trouble, was successfully accomplished by cutting away a 3 in. length of the barrel opposite the combustion chamber, closing the leak by silver-solder and restoring the barrel by a wrapper, having lapped, screwed and silver-soldered joints which are all hidden by the lagging.

Peering in the firebox of one of my boilers recently I was surprised to see bulges [redacted] both sides of the combustion chamber, [redacted] sketch. These had evidently been formed at some time when pressure was particularly high.

They do not affect the steaming noticeably and the brazed joints [redacted] the ends [redacted] intact; but the next combustion chamber to be made will be of the correct gauge of metal, and careful thought will be given to the positions of the water-tube stays, also the blowing-off point for this boiler and others will in future be frequently checked.

The first boiler for "Monstrous" [redacted] never completed, the firebox, combustion chamber and flues were put out to be brazed by [redacted] specialist firm.

In pickling the job, neat acid [redacted] added to the vat by someone unaware of the contents, with the result that over [redacted] week-end the plates and thin



Bulges in the Combustion Chamber

tubes were eaten away too much to be serviceable, necessitating a fresh start.

The second boiler got as far as a pressure test, when the firebox girders parted from the outer wrapper and defied all my efforts to restore. This was due, I believe, to insufficient heat in the hard-soldering.

Third time was lucky, however.

Another boiler, having internal leaks, was passed to [redacted] firm for tinning on the inside; tinned it was, but the pickling had been so severe as to burn all the fine threads in the bushes. Subsequent examination of the inside showed flues locked together with solder.

I have never yet tried the compound used for stopping leaks in car radiators; it may come to that, who knows!

I [redacted] that these tales are sad ones. If I might point [redacted] moral I should say that it is essential to [redacted] the correct gauges of copper sheet and tube and to be meticulous in the spacing and diameters of stays, and the threading of them.

Extreme Caution

If one disregards "L.B.S.C.'s [redacted] recommendations in these respects, it is with considerable risk of failure.

I agree, too, that the secret of good joints is plenty of heat! [redacted] often stressed by [redacted] L.B.S.C."

In this connection, it may be that the novice is likely to be overawed by the blowlamp. My first reaction certainly was one of respectful caution; imagination pictured the bursting of the container.

Familiarity cures that complex, however, and [redacted] five-pinter becomes [redacted] friend and makes [redacted] admirable pipe lighter.

But [redacted] five-pint blowlamp can be [redacted] real menace in [redacted] small workshop. If insufficiently preheated it is prone to do [redacted] flame-throwing act, squirting liquid paraffin, then one wishes the walls and ceiling were covered with asbestos.

Familiarity

The oxy. man may well "cock a snoot" at his less fortunate and hot-and-bothered brother of the blowlamp, and much of the foregoing may leave him cold, literally. Perhaps he has problems of his own, however!

For the Bookshelf

Locomotive Stock Book, 1950. (Published by the Railway Correspondence and Travel Society at 18, Holland Avenue, Cheam, Surrey.) 63 pages, size 6 in. by 8 in. Illustrated. Price 10s. net.

It is two years since the previous edition of the *Locomotive Stock Book* was published, and much has occurred to the stocks of locomotives in Britain and Ireland since that time. This new edition of the *Stock Book,* however, duly records all the changes that have taken place and includes complete lists of all locomotives (steam, diesel and electric) [redacted] they were at December 31st, 1949. The voluntary compilers and editors of this book deserve the highest praise for the energy, enterprise and enthusiasm which they have brought to bear in their gigantic task. Due to so much renumbering and reclassification having taken place since the publication of the previous edition, large sections of this book had to be rewritten and rearranged, while the whole of it has been, to [redacted] greater or lesser extent, reorganised. The result is [redacted] triumph for those who undertook it.

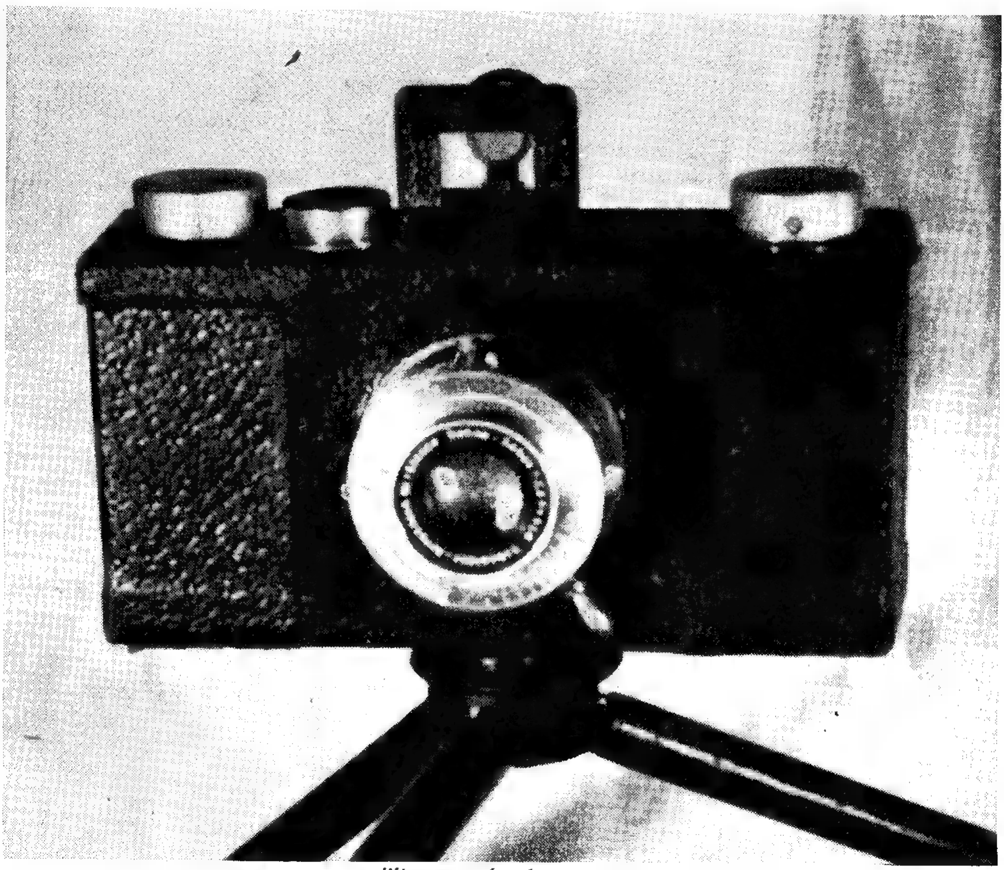
The 78 illustrations record all classes that have become extinct during the two-year period.

An Inexpensive 35 mm. Camera

by John R. Russell

FINDING precision miniature cameras far too dear for my modest means, and yet requiring [redacted] high performance miniature in connection with my 35 mm. film strip projector, I decided to try making my own.

Two successful cameras were made, using the lens from [redacted] G.45 gun camera, and shutters from damaged cameras, using [redacted] 1-in. square



The completed camera

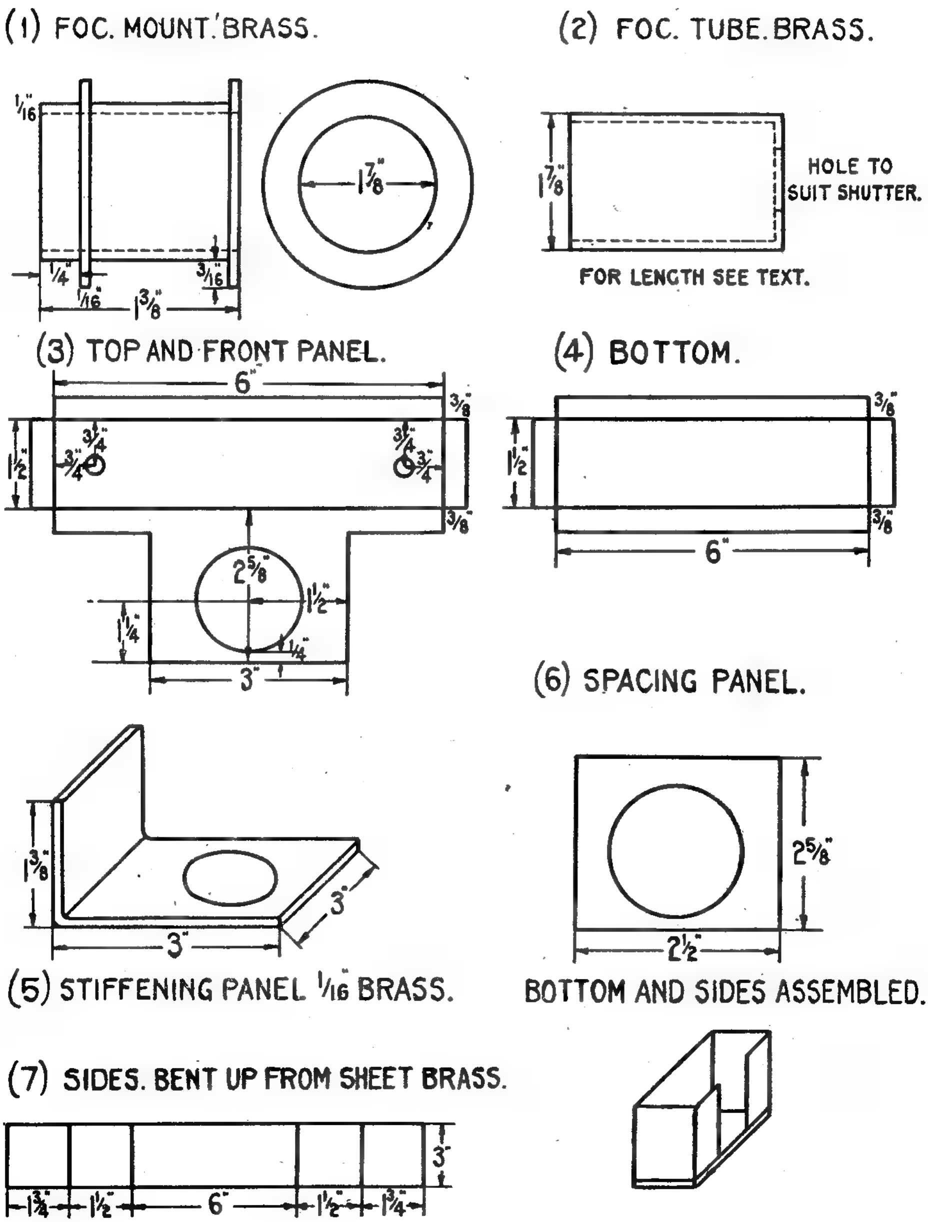
format on 35 [redacted] film. Fired by this success, I built the [redacted] illustrated; it takes [redacted] 5 cm. F2.8 Xenon lens in a Compur Rapid shutter (as fitted to the Retina 2, costing about £40-£50 second hand). This lens and shutter cost only £7 10s. 0d., and [redacted] in mint condition. Any 5 cm. lens in [redacted] shutter could be fitted to the camera, and such lenses are often advertised, quite reasonably priced, in the photographic journals.

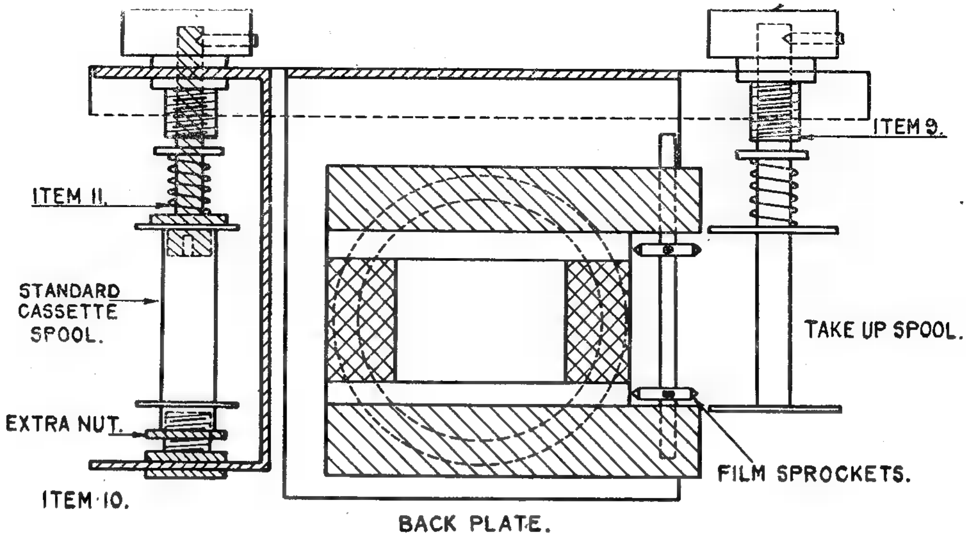
With the exception of the focussing tube and mount, very little precision work is called for, and most of the odds and ends were turned up on my own lathe, a somewhat battered "Adept." Focussing down to 3 ft. is carried out by revolving the lens and shutter tube, which works in [redacted] helical slot. The focussing mount, [redacted] tube flanged [redacted] one end, is rigidly secured to the front and top of the camera; this ensures that the lens-film distance remains constant for each setting. The top of the camera, complete with focussing mount and tube, winding, and counting mechanism, etc., slides up out of the body for loading or unloading, which may be done in daylight; 36 Leica-size (36 × 24 mm.) pictures may be taken on [redacted] standard cassette of film.

As no gear cutting facilities were available, the film counter was made up from bits and pieces

of [redacted] old alarm clock, but works quite well. The body is bent up from 24 g. sheet brass riveted and soldered. An optical viewfinder from [redacted] old plate camera, suitably masked down, [redacted] fitted, pending the construction of [redacted] neater arrangement. On the particular Compur Shutter used, no provision was made for a cable release, this being essential if camera-shake, the enemy of miniature cameras, is to be kept to the minimum. I therefore fitted [redacted] small bracket to the focussing tube, tapped to take a cable release. A standard cable release was then modified to form [redacted] fork end, the release was screwed into the bracket, so that the fork engaged the trigger release. This does not interfere with the normal working of the shutter.

An ever-ready case, made up from old hand-bags, a tin can, and some velvet effectively safeguards the somewhat exposed shutter and lens.

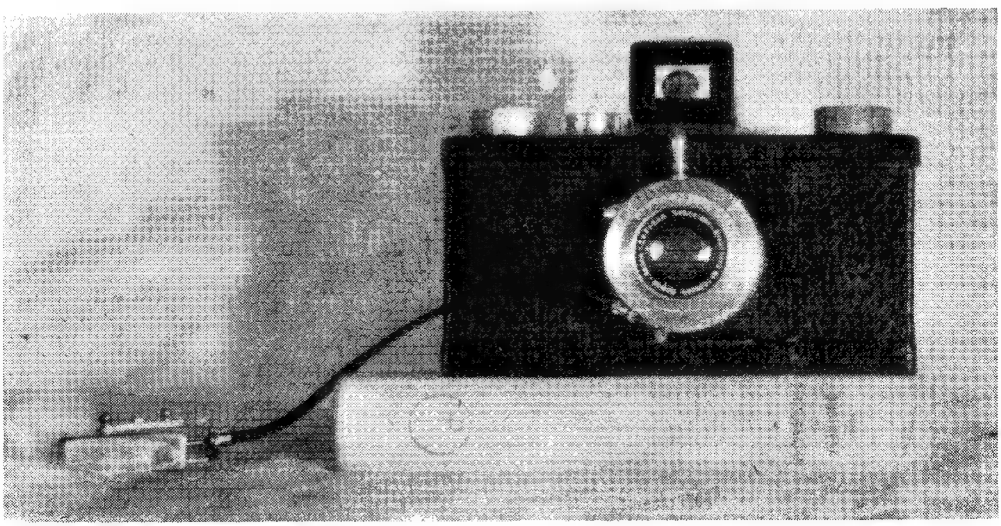




Results so far obtained have been extremely good. Tests with a performance chart at full aperture show resolution figures of nearly 80 lines per mm. of negative, and this figure could probably be increased by accurate exposure and development as well as correct lighting of the test charts; however, enlargements up to 15 in. × 12 in. have been made from negatives taken by this camera, showing no appreciable unsharpness to the naked eye. The camera is finished off by a covering of thin leather, securely fixed with "Durofix" or balsa cement.

Constructing the Camera

The drawings show most of the necessary items; assuming a suitable lens and shutter have been obtained, a start should be made on the focussing mount, item 1. The wall thickness suggested is $\frac{1}{16}$ in., but this is not critical. The bore must be smooth and flawless, and the back and front flanges exactly at right-angles to the bore at every point. Before making the focussing tube, the exact focal length of the lens must be found. Set the shutter to time and place the end of a ruler against the shutter mount, not the threaded portion carrying the locking ring, but the actual back of the shutter. Apply a piece of ground glass (ground side towards shutter), and move it backwards and forwards until objects 150 yd. or more distant are in sharp focus; a

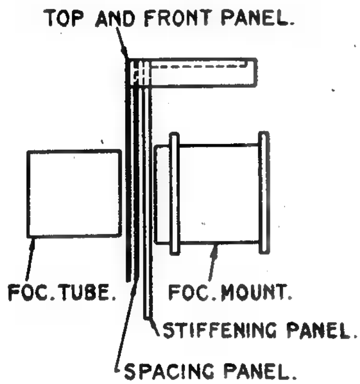


"Self portrait," taken with camera described in this article, using a mirror and an automatic release

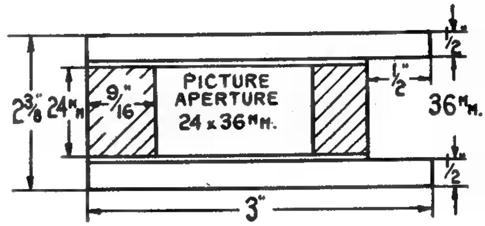
strong magnifying glass will be useful for checking accuracy of focus. When satisfied, measure the distance from the shutter to the front of the ground glass. This measurement less $\frac{1}{8}$ in. is the length of focussing tube required. (In my [redacted] this measurement is $1\frac{13}{16}$ in.) The focussing tube must be [redacted] perfect sliding fit in the focussing mount, with [redacted] play whatsoever, and again, ends must be absolutely at right-angles to the length.

A circular hole should now be cut in the blanked off end of the focussing tube to suit the shutter used, and the shutter may be secured to the tube by [redacted] of the locking ring normally provided. An improvement here, if screwcutting facilities [redacted] available, would be to increase the thickness of the blanked off end of the focussing tube, and to thread the hole to suit the shutter mount, so that the lens and shutter may be removed easily if required. Item [redacted] may now be made from 24- or 26-g. sheet brass. The [redacted] thickness of sheet chosen must be used for Items 4, 6, and 7, [redacted] well. Bending allowances are not shown. The $\frac{3}{8}$-in. flaps around the sides and back must be turned up [redacted] right-angles, also the front panel. The corners should be

FOCUSSING ASSEMBLY.



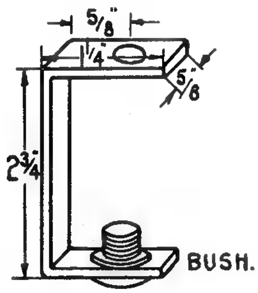
(8) BACK PLATE (SEE TEXT).



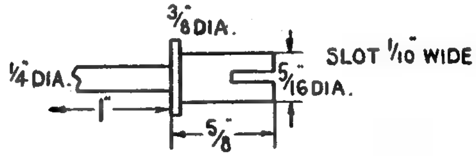
(9) BUSHES 1/4" BORE FROM VOLUME CONTROL.

3 REQUIRED.

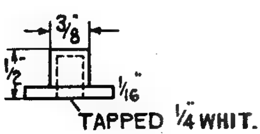
(10) CASSETTE HOLDER 1/16" BRASS.



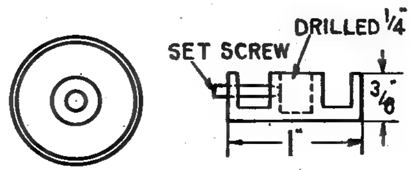
(11) REWINDING KEY. BRASS.



(12) TRIPOD BUSH.



(13) KNOBS DURAL. 1" DIA 3/8" THICK. (2).



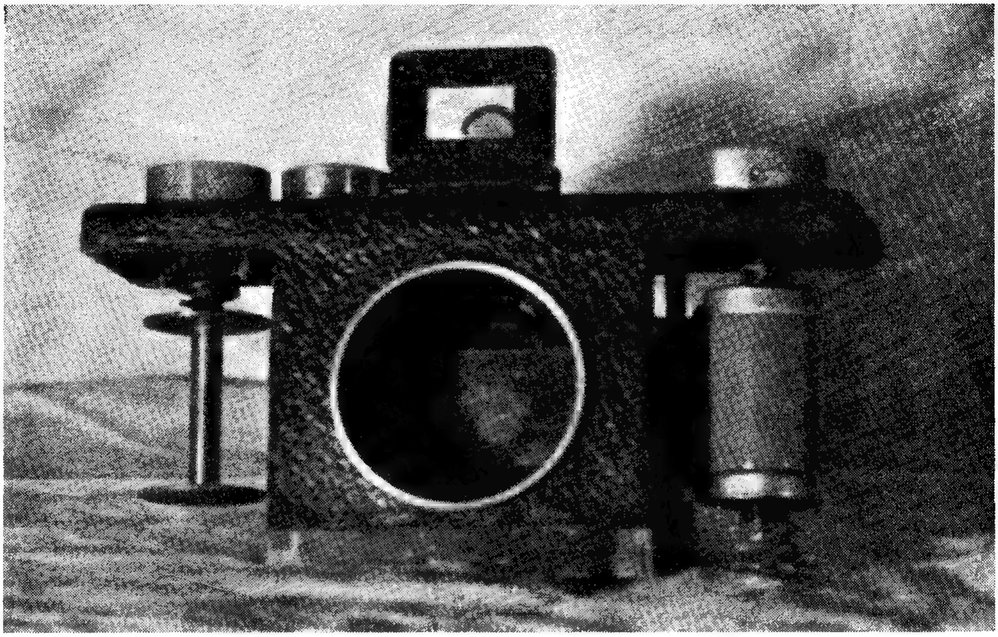
soldered, making sure no solder is left on the inside, and reinforced on the outside if necessary. Drill two holes as shown, clearance size for Item 9.

Items 5 and 6 should now be made, paying particular attention to accurate marking-out.

Assembly

Item 6 is placed inside the front panel with the 6-B.A. countersunk screws, making certain that the picture aperture, top and bottom, is parallel with the top of the camera and central with reference to the focussing mount.

Item 4 needs no comment. Sides are bent up as for the camera top. Item 7; measurements for this are best made from the bottom tray, as it has to fit snugly inside (bending allowances are not given). When Item 4 and Item 7 are



Showing cassette, take-up spool and focussing mount

$2\frac{1}{2}$ in. edge against the top, allowing $\frac{1}{4}$ in. each side; the stiffening panel, Item 5, is placed next to the spacer, and the pieces temporarily fastened together. A circle of 1-in. radius is now scribed on the front panel (see Item 3), and a 2-in. hole is cut through the three thicknesses of metal. The focussing mount is now fitted into the hole and secured by means of four B.A. countersunk screws, spaced equidistantly round the circumference, similarly the top part of the stiffening panel is secured to the camera top. (See focussing assembly sketch.)

Item 8, the backplate, may be made from $\frac{3}{16}$-in. brass plate, if facilities are available to mill a $\frac{1}{16}$-in. deep channel 35 mm. wide, and a further channel 1/64 in. deep, 24 mm. wide. Failing this it may be made from $\frac{1}{8}$-in. brass, with $\frac{1}{16}$-in. strips sweated on to form the film channel. The 1/64-in. deep channel may be carefully filed down. This is the method used for the camera illustrated. Whichever method is adopted, the backplate must be perfectly flat, and brought to a smooth polished finish to prevent scratching the film surface.

The 24 × 36 mm. film aperture may be cut out as shown and the back plate fixed to the back flange of the focussing mount by means of completed, rivet them together and run in some solder to ensure light tightness. Test the work so far by placing the front panel over the gap in the front of the body so that the sides slide up into the grooves formed by the spacing panel; the lid should fit snugly over the sides. Next, make Item 10, the cassette holder, from a strip of $\frac{1}{16}$-in. × $\frac{5}{8}$-in. brass, bent up as shown. Drill a hole in each end to suit the outside of the threaded bush (Item 9). Fit one of these bushes at one end, take another threaded bush and fit it in to the right-hand hole, place the cassette holder over this and secure with one or two nuts. (See camera back sketch). Item 11, the depth of the slot will need to be found by experiment. Slip a short length of spring over the $\frac{1}{4}$-in. diameter end, and a suitable washer, and push it through the bush in the camera top; put one of Item 13 on the end and secure it with a grub screw. A standard metal cassette should now be obtained. Take out the spool and fit it into Item 11, so that the slot engages in the keyed end of the spool. Next, obtain a length of 35 mm. film, and lay it in the film channel. Place an extra nut on the bush at the bottom of the cassette holder and adjust it until the spool lies directly in line with the film channel. Once this position

has been found, solder the nut in place. By lifting the knob, it should now be possible to remove the spool.

In the left hand hole in the camera top, fit another Item 9. Now take a piece of $\frac{1}{4}$-in. brass rod about $2\frac{3}{4}$ in. long, and at one end, solder a washer 1 in. diameter $\times$ $\frac{1}{16}$ in. thick with a central $\frac{1}{4}$-in. hole. 36 mm. away from this washer, solder another one exactly the same size. Slip ■ short piece of spring over the free end, plus a suitable washer, and push through the bush in the camera top. This constitutes the take up spool and it must be adjusted to lie in line with

Showing focussing tube with shutter fitted, also focussing slot. (The barrel is not an essential component)

the film channel. When the correct position has been found, secure with the other Item 13 cutting off any surplus rod. Test the correctness of adjustment by winding two or three feet of 35 mm. film from the cassette on to the take-up spool. The film should be attached to the take-up spool with cellulose tape. The drawing of the camera back should make all the above notes clear.

The Counting Mechanism

A Leica sized negative takes up just over seven perforations, so if an eight-toothed sprocket is made it will make one complete revolution for each frame exposed. As I had no method of cutting these sprockets in my lathe, they were made up from two $\frac{1}{2}$-in. square pieces of $\frac{1}{16}$-in. brass, these were drilled $\frac{1}{8}$ in. in the centre and sweated together, one being turned through 90 degrees; this forms an eight-pointed sprocket. The teeth now need to be filed into shape. This is a matter of trial and error. Two of these sprockets should be made and fitted to ■ $\frac{1}{8}$-in. diameter brass rod, checking the distance between them by means of ■ spare piece of film. These need to be placed as shown in the back view of the camera, the spindle running in suitable brackets fixed to the underside of the back plate. Winding on the film should now cause these sprockets to make one full revolution for each eight perforations in the film. The shape of the sprocket teeth may need slight alterations. Some sort of gearing to turn this complete revolution into ■ 1/36 of a revolution, shown on an indicator outside the camera, is now required. A 35-toothed wheel on the sprocket spindle, engaging in ■ 36-toothed wheel on ■ separate spindle, passing through the camera top and carrying ■ disc divided into 36, would do admirably. In the camera described, a 36-toothed wheel from an alarm clock is mounted so that a peg on the sprocket spindle moves it one tooth at ■ time; outside the camera, this movement is shown by means of ■ dural disc of $\frac{3}{4}$ in. diameter marked off in 36 divisions, each five being indicated by means of number punches; however, I leave this to your own ingenuity. Some sort of click or other positive indication is also required to prevent over-winding.

Focussing

Fit the lens and shutter into the focussing tube, screwing up the locking ring securely. Place ■ piece of ground glass in the film channel, ground side facing the lens, push the focussing tube right home, and set the shutter to *T*. Check that the distant object is still sharp. If not see if it can be focussed by moving the focussing tube slightly out. If this clears up the trouble, remove the shutter and fit some packing washers of thin metal to set the shutter slightly forward and replace. If the fault cannot be cleared by these means, the focussing tube is slightly too long, and must be reduced. When satisfied, remove focussing tube, and in the focussing mount, about $\frac{3}{4}$ in. away from the back plate, near the bottom of the camera, drill a small hole. Replace the focussing tube, pushing it right home, and mark it through the small hole in the focussing mount. Now without pulling out the focussing tube turn it through 180 degrees, and then gently slide it forward until objects about 3 ft. away are sharply in focus. Again mark the focussing tube through the small hole. Take out the focussing tube and using ■ piece of thin metal as a guide, join up these two marks. Carefully cut ■ slot along this line just wide enough to take a 6-B.A. screw. The slot must be accurately cut, otherwise the focussing will be erratic. Tap the hole in the focussing mount to take ■ 6-B.A. screw, insert the focussing tube and screw in ■ suitable 6-B.A. screw. Rotating the lens and shutter assembly should now move the focussing tube backwards

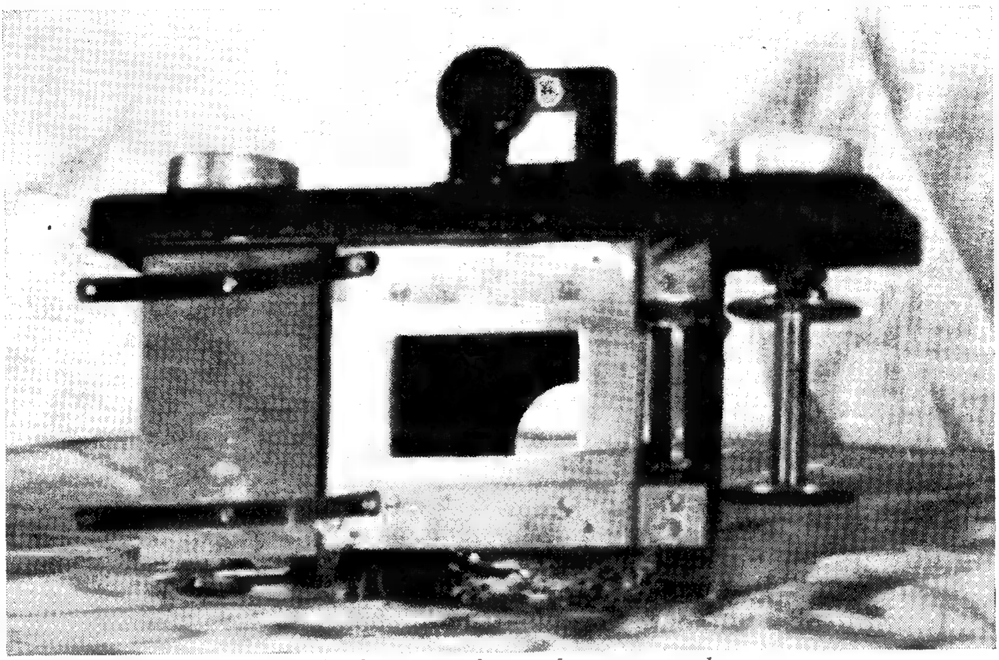
and forwards. The focussing knob (an alarm clock foot, to be more exact), is screwed to the focussing tube to afford a better grip when altering the focus (see photographs).

Glue a piece of paper around the focussing tube to form a temporary scale, and scribe a line on the projecting part of the focussing mount. Now focus on objects at 3 ft. again and put a pencil mark on the paper at this point; repeat this for all required settings. Later on, when test shots have been taken and the exact position has been found, these settings can be scribed through the paper, and the distance marked on with the number punches.

A suitable viewfinder can now be fitted to the camera top central to the lens. With the ground glass in position, check that the viewfinder covers the same picture as seen on the ground glass, and mask down with black tape if necessary. It is a good plan to make the viewfinder show slightly less than the actual negative.

The pressure plate can now be fitted. Make this of $\frac{1}{16}$-in. brass, 35 mm. wide by $2\frac{1}{2}$ in. long, and mill or file out a channel 24 mm. wide to prevent it touching the actual picture area, about 1/64 in. deep will be ample. Finish off with flour emery and polish on a buff. This drops into place in the film channel, and may be secured with light flat springs (governor springs from an old gramophone motor are suitable).

The camera body and top may be covered with thin leather as stated. Every part of the inside must be painted with flat black paint to prevent reflections. The pressure plate may be left polished, or chemically blackened if desired. The tripod bush should be fitted in the centre of the camera about $\frac{1}{2}$ in. from the front edge by drilling a hole, and soldering it into place. The cassette holder will need some arrangement to prevent the whole cassette turning when the film is re-wound. I have not bothered with this as I always unload the camera in the darkroom, to avoid having to wind the film back into the cassette, which doubles the risk of scratches and it is just as easy to unload the film from the take-up spool.



Details of pressure plate and counter sprockets

Loading and Testing

Use a fine grain panchromatic film for testing. Open the camera, lift up the re-wind knob and fit the cassette into place. Thread the end of the film under the pressure plate and over the sprockets. Fix the film to the take-up spool with a short piece of cellulose tape. Close the camera and wind on two revolutions (two frames on the indicator). The camera is now ready for use. To test the accuracy of the focussing scale, take several shots of a sheet of newspaper pinned to a wall at different settings fairly close to the pencilled setting. Repeat these shots at all distances up to 12 ft. or so. It is useful to have a card clearly marked with the distance you are testing pinned up alongside your test sheet; this helps to prevent any mistake when examining the negatives.

When the correct setting for each distance has been established, mark off the focussing scale permanently as described.

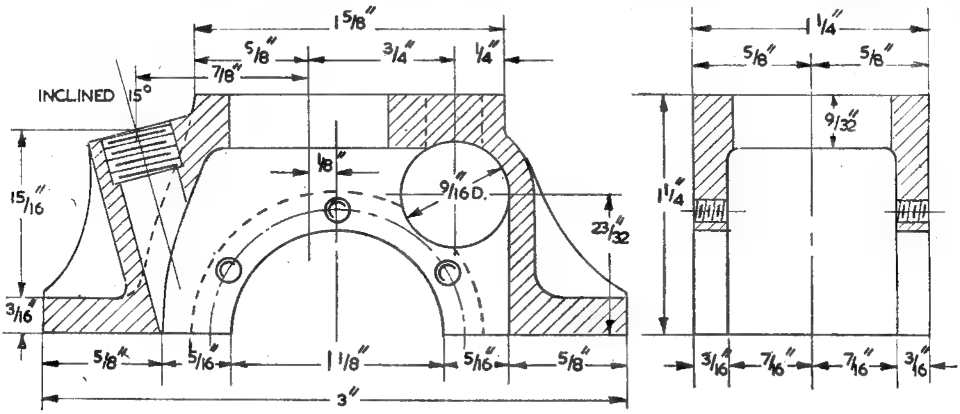
A case for the camera helps to protect the lens and the shutter against accidental knocks. This can be easily made up from odd pieces of leather.

PETROL ENGINE TOPICS

*A 10 c.c. Twin Four-Stroke

by Edgar T. Westbury

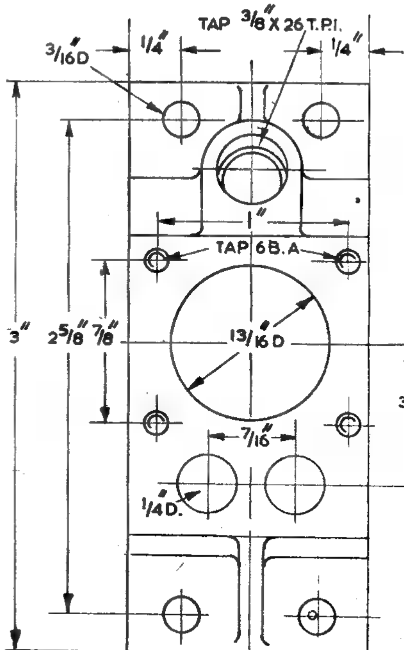
IN the concluding instalment of this series, I propose to deal with possible modifications and mutations of the "Seagull" engine design, some of which have been asked for or suggested



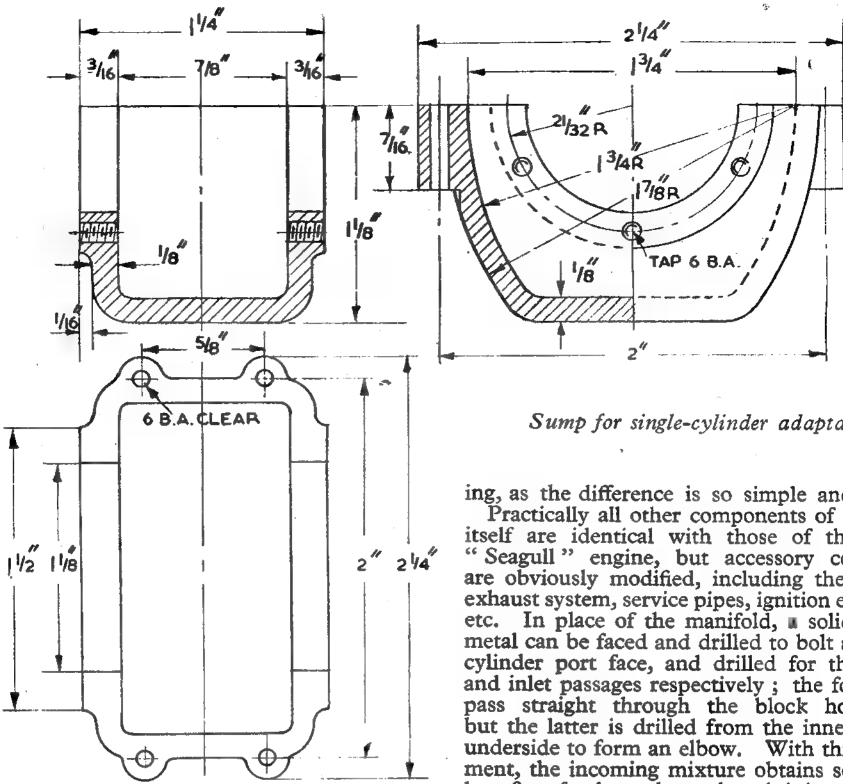
Crankcase for single-cylinder adaptation of "Seagull" engine

by readers, and others in anticipation of possible requirements. As I have so often observed, I am a great believer in making designs as adaptable as possible, because model engineers are staunch individualists, who do not readily accept or conform to stereotyped standardisation either in design or methods of construction. My experience in the past has been that no two readers have precisely the same ideas as to what they wish to construct, or on details of design; and even when they work ostensibly from the same drawings, the results are rarely identical in any two cases. So far from criticising or objecting to this trait, however, it is my object to encourage and cater for it to the best of my ability, as I consider that it adds to the interest of model engineering, and enhances that variety which has been truly called "the spice of life."

As promised in the December 7th issue, I have made drawings of some of the main components necessary for modified versions of the "Seagull" engine, including those for converting it to single-cylinder form. The most important of the components in the latter case is the crankcase, which is shown herewith. Its general principles of design are the same as in the twin, including its division on the horizontal centre-line, and the mehod of attachment of the other structural parts; but it is obviously simpler to machine, being shorter and without the centre



*Continued from page 889, "M.E.," December 7, 1950.



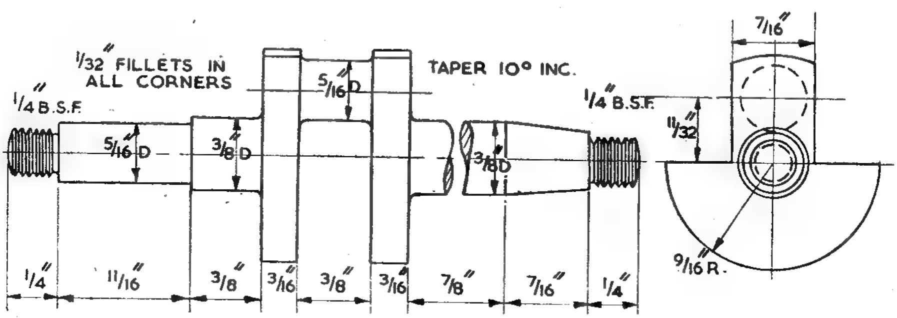
Sump for single-cylinder adaptation

split bearing, though it may be machined by much the same methods.

The crankshaft must also be altered, by the elimination of one complete throw and the centre journal, [redacted] shown in the detail drawing. Here again, the same methods of setting out and machining are applicable, and the greater stiffness of the shortened shaft will simplify machining problems. The camshaft will have to be similarly reduced in length, with the elimination of two of the cams, but in this case it has not been considered necessary to show [redacted] new detail drawing, as the difference is so simple and obvious.

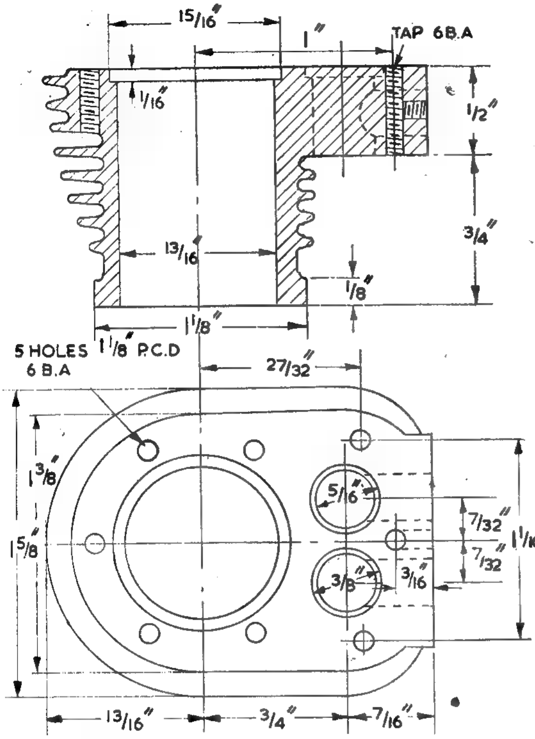
Practically all other components of the engine itself are identical with those of the original "Seagull" engine, but accessory components are obviously modified, including the inlet and exhaust system, service pipes, ignition equipment, etc. In place of the manifold, [redacted] solid block of metal can be faced and drilled to bolt against the cylinder port face, and drilled for the exhaust and inlet passages respectively; the former may pass straight through the block horizontally, but the latter is drilled from the inner face and underside to form an elbow. With this arrangement, the incoming mixture obtains some of the benefits of exhaust heat, though it is not [redacted] effective as [redacted] "hot-spot" manifold. An alternative arrangement is to use separate fabricated exhaust and inlet pipes, with flange joints, the inner ends of the flanges being truncated, as previously described, to enable them to be clamped by [redacted] single centre nut.

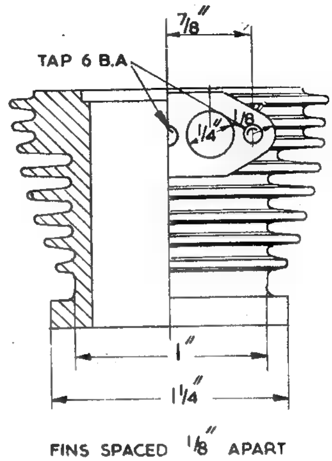
The carburettor requires no modification, as the bore of the choke tube is proportional to that of the cylinder, [redacted] general rule, irrespective of the number of cylinders, up to four. If one wishes to obtain maximum power from the engine, some experiment in the size of the choke may be justified, but flexibility will suffer if it is opened up too much.



Details of single-throw crankshaft

In the case of the contact-breaker, it is only necessary to alter the cam to produce a single break per revolution, and of course an ordinary single-spark coil can be used. It has been suggested that the dual-spark coil should be retained, and two sparking plugs fitted to the head, "to improve the certainty of ignition," but while there is no objection to this, I do not consider that there would be much advantage in it. If it is practicable to convert the engine to air-cooling. This possibility had already been envisaged in the design, and detail drawings of air-cooled cylinders were made, but they have not hitherto been published as it was thought that the characteristic appearance of water-cooled cylinders would be preferred both by marine and car enthusiasts. However, here they are, and from the practical point of view it may be said





Air-cooled cylinder for "Seagull" engine

one plug should oil up, the chances are that the other one would be in a pretty bad way too. Despite the theoretical advantages of two-point ignition, it has not been found of sufficient benefit to justify its adoption in normal types of automobile or marine engines, except in very large sizes, where the rate of flame propagation in the cylinder often has an important influence on efficiency.

Unless the bore and stroke of the engine are altered (there is some latitude in this respect allowed for in the design) the single-cylinder version will, of course, be of 5 c.c. capacity. In order to distinguish this type from the twin, it will be known as the "Seamew" engine, and should it show signs of becoming popular, full detail drawings, and castings for its construction, will be made available in due course.

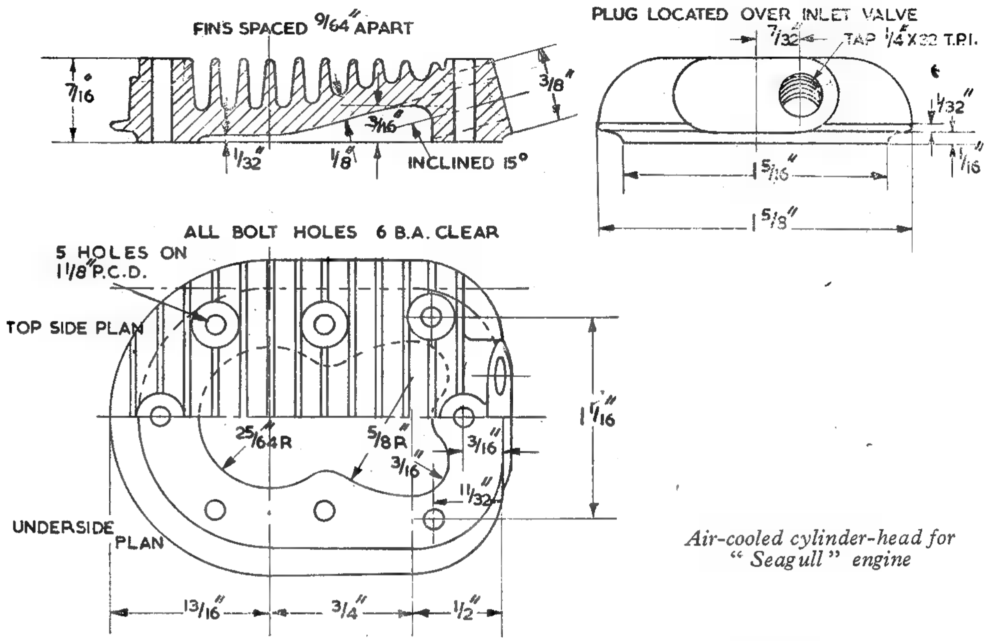
Air-cooled Cylinders

Some of my friends who would like to use the "Seagull" engine in model cars are very perturbed about the problems involved in fitting a water cooling system, and have asked whether that they will give equally good results as the water-cooled type in either of the above applications. In the case of slow-moving boats, it will probably be found desirable to fit a fan on the engine shaft to assist cooling, the most satisfactory type being an enclosed centrifugal fan with ducts to direct the air on individual cylinders.

The air-cooled cylinders are directly interchangeable with the water-cooled type, including the fitting of the liners, involving no alterations to other components, but it will be necessary to cut back the finning on the inner side of each cylinder and head, to the line shown, in order to get them in at the normal spacing, without fouling. If, however, the single-cylinder air-cooled version is built, the fins should be left full on both sides. Either the single or twin air-cooled version would make quite a neat and serviceable engine, though more in keeping with motor-cycle practice than with automobile or marine types.

I have also had requests for overhead-valve cylinders from some readers, but while I agree that they are perfectly practicable, and would

enable higher power to be obtained from the engine, there are some rather delicate problems in the design of a really neat and efficient head for such a small cylinder, and the amount of research work which would be entailed could only be justified if the demand is sufficiently large. It would be practically essential to use a die-casting for the head, in order to ensure sufficient accuracy and clean detail, and my experience with die-castings so far is that it is very difficult to ensure that a sufficient number of them will be sold to pay the cost of the dies. While I have no personal interest in the business of selling castings or other model supplies, I cannot disregard the economic aspects involved therein, as I have to secure the co-operation of trade firms in getting material of the right quality made available to readers. For the present, therefore, the overhead-valve proposition is shelved, though it is not by any means forgotten, and it is entirely up to you, readers, whether it ever materialises or not.



Air-cooled cylinder-head for "Seagull" engine

A "Flat Quad" Engine ?

One of my friends is very keen on producing a four-cylinder engine of the type composed of two horizontally-opposed pairs of cylinders, and has hit upon the ingenious idea of using what amounts to a double "Seagull" engine, by taking two of the standard crankcase castings, without the lower halves, and bolting them together with the joint line in the vertical plane. The two sets would amount almost to complete engine units, with their own separate camshafts and timing gears, but only one crankshaft would be used, with two throws opposed at 180 deg., the crankshaft journals being wide enough to accommodate two big-end bearings each.

On the face of it this would appear quite practicable, but one serious practical snag is that with desaxe cylinders as employed in this engine, opposing the blocks in this way would mean that one half of the engine would be running in the wrong direction to take advantage of the offset thrust. This would not prevent the engine from working, but would probably result in loss of efficiency, and the side thrust on the pistons on this side would be increased, tending to reduce the wearing life of the working parts.

Among other disadvantages of this arrangement, the endwise space available for the crank throws allows hardly enough room for two big-end bearings side by side on each pin, and it would be necessary to skimp their width to an undesirable extent. Unless the cylinders of the opposed pairs were staggered, offset thrusts would be produced on the connecting-rods, which might lead to bearing trouble. An alternative would be to use forked rods, but they would be finicky to fit in so small a size.

With both the oil filler lugs at the bottom, it would be necessary to make special arrangements for checking oil level, and for crankcase ventilation. Exhaust and inlet manifolds would either have to be complicated or two separate systems used. Cam timing and ignition systems would also call for modification, and the same would apply to the method of engine mounting.

All things considered, I think I should very much prefer to redesign the crankcase if I decided to build an engine on these lines, allowing more space for the rather crowded internal working parts, and using a single camshaft with eight cams, as in the "Seal" engine, but modified in respect of the relative indexing of the cams for respective cylinders. A barrel type crank-

case would be appropriate, but it would be desirable to fit a detachable lower section to form a sump and also allow of access for assembly of the big-end bearings. However, the proposition is by no means an unattractive one to the ambitious constructor, and it is only this scheming and contriving to produce "something different" that makes us model engineers the stout fellows that we are !

Castings and Supplies

The castings for the "Seagull" engine can be obtained from Craftsmanship Models, Ltd., of Ipswich, whose experience with the "Seal" and other engines of my design qualifies them to deal with supplies of this nature. I would again emphasise the importance of obtaining castings from authorised suppliers, who work from the original patterns, and co-operate with the designer by producing the castings under personal supervision. Many complaints are received from readers who obtain castings and parts from unauthorised sources; in many cases the specifications of materials are at fault, and the quality and accuracy of castings very poor indeed. One often finds evidence that such suppliers have not even gone to the trouble of making patterns, but have cast the parts off a set of someone else's castings, thereby introducing double shrinkage and slurring of detail accuracy. Such castings may be a little cheaper—but they are dear at any price, and there is nothing I can do about it except issue due warning to readers. Good constructional material is absolutely essential to producing successful models, and i.c. engines in particular, and it is my aim is to see that readers get it. A good casting is a thing of beauty and a joy for ever; its quality lends a distinction to the finished product, whether it is destined for the exhibition stand or the field of utility. How often have I been moved to tears by the sight of engines purporting to be of my design, but falling a long way short of justice to it, sometimes through the lack of the constructor's skill, but far more often through the use of poor basic material !

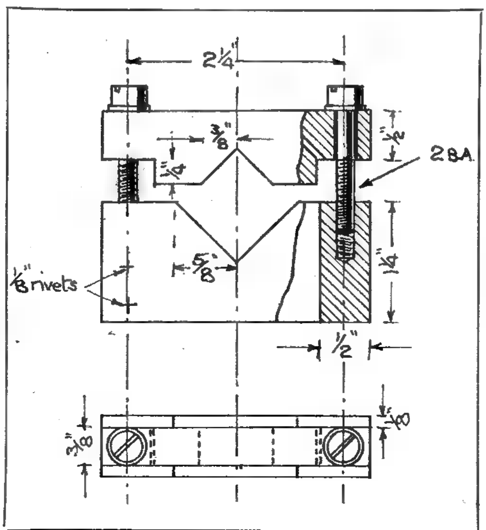
From the splendid efforts in the interpretation of my designs in the past, I feel sure that readers will not let me down with this one. I will conclude this description by expressing, at this festive season, my sincere good wishes to all readers, whatever their particular activities or preferences may be. We cannot all hold the same views; our skill and facilities must necessarily vary widely, but we are all inspired with a love of good engines and good craftsmanship, and whatever any of us may have to endure in the way of shortages and restrictions this Christmas, there is at least one stimulant none of us will be short of—the Spirit of Model Engineering !

VEE-BLOCKS

by A. Smith, M.Coll.H.

In amateur workshops, particularly those where metalwork is done, vee-blocks have a very wide use, not only on the drilling machine table but also for marking-out. It is very often the case that the shallow-pocketed amateur prefers to "make do" rather than buy what often turns out to be expensive pieces of equipment, and it is with this idea in mind that I offer the following design for a pair of vee-blocks which, while easy and cheap to make, will prove of immense value on the surface-plate and drilling machine.

The drawing shows clearly the construction, and while dimensions are given, these may be modified to suit individual requirements or the material to hand. Steel plate of ⅛ in. thickness is used for the sides, and as a pair would be made, the four sides should be worked together to ensure that they are all exactly similar. The distance-pieces are of ½-in. by ⅜ in. section,

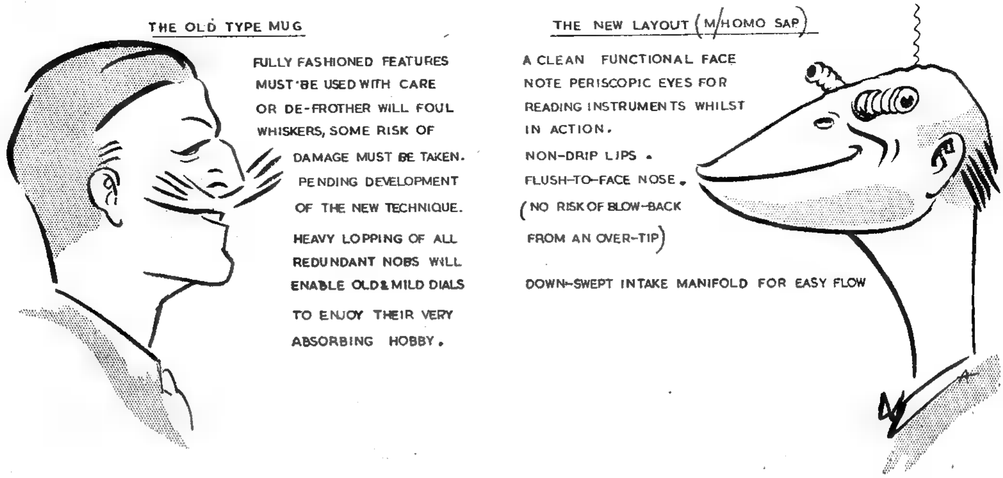


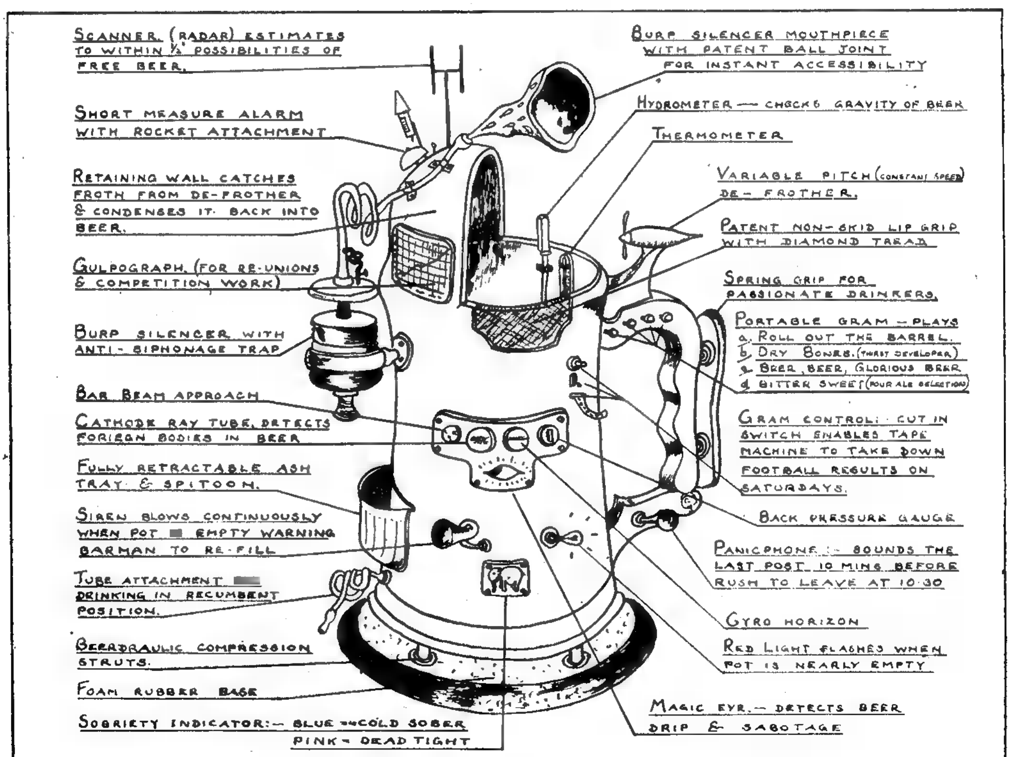
and in drilling the rivet holes in both these and the sides, it is advisable to use one side as a master copy.

The clamp is made from ¾ in. by ⅜ in. section bright steel, and here again the pair should be worked as one to ensure similarity. Notice that the lower ½ in. of the clamp fits between the distance-pieces of the base and should slide easily up and down between them.

In cutting the upper and lower vees, it is advisable to drill a $\frac{1}{16}$ in. hole at their apexes, otherwise difficulty will be experienced in filing to an accurate and sharp corner. With the clamps in place, a No. 26 drill should be put through either end into the distance-pieces as shown. The distance-pieces should be tapped 2 B.A. and the clamps opened out with a No. 11 drill. Two 2-B.A. cheese-head screws are then fitted to each block and they are ready to form a useful part of the workshop equipment.

THE SHAPE OF THINGS TO COME? (with pink elephants)





THE PATENT PINT POT — B.S.S. — 5' x.x.x. BRITISH PATENT R/∝√100 : 1		SCALE 1/8 FULL SIZE		
DESIGNED BY	H. O. P. FIELD (B.Sc. PROF.)	APPROVED BY	BEER DRINKERS UNION	DRG. 04 A. P.P. POT
DRAWN BY	I. B. A. GUZZLER (R.A.)	ISSUED BY	BOOZE SESSION ORGANISERS.	
CHECKED BY	DRS. BLACK & TAN	FINISHED	NOT ?★? LIKELY.	
TESTED BY	JOHN CHINSTRAP (COLONEL RET)	SHOP INSTRUCTION	AS REQD! / FOR THE NATIONAL TRUST.	

TEST REPORTS

Some expert comments upon items submitted by the trade

Items in the "Eclipse" Range of Tools

MESSRS. JAMES NEILL & CO. LTD., of Sheffield, have submitted a number of tools for inspection and test. These tools are of considerable interest, and the reports upon them which follow are based on experience gained after using them for some time.

The "Eclipse" Instrument Vice. No. 180

This small vice, which is illustrated in Figs. 1 and 2, has been designed to meet the needs of those who do small and intricate work.

As will be seen from the illustrations, the G-cramp, which forms the basis of the device, is of robust construction and allows the unit to be clamped firmly to the bench or to a piece of hardwood which, in turn, may be held in the normal bench vice. This latter mounting is somewhat more comfortable for those operations which are best carried out while standing, as the work is then raised higher; an advantage, sometimes, when delicate work is being undertaken.

The horizontal member, in which the vice itself is held by means of a cross-handled locking-screw, passes through the head of the G-cramp, which is split axially and can be contracted to grip this member in any desired position by turning the locking-nut seen at the base of the cramp.

The vice, which is of quite simple construction, has parallel jaw movement and is mounted upon a stalk some 3 in. long. This stalk has four flat surfaces machined upon it, all at 90 degrees to one another. These surfaces allow the head of the vice to be firmly clamped at four separate stations. In addition, since the head of the horizontal member itself has a V-groove machined in the passage through which the stalk of the vice passes, it is possible to orientate the head of the vice through a further four stations at 45 degrees to those already mentioned, and thus to lock it positively in eight positions.

The jaws of the vice itself are made from $\frac{1}{2}$-in. square steel, and their top surfaces are bevelled at some 30 degrees to leave a land $\frac{1}{8}$ in. wide running up to the face. A small

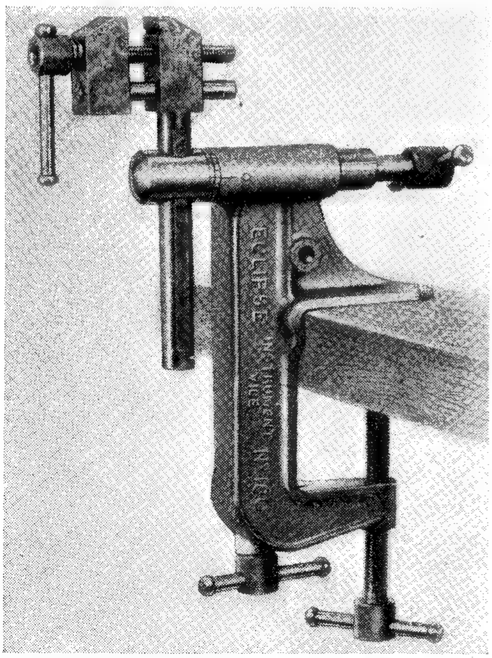


Fig. 1. The "Eclipse" instrument vice

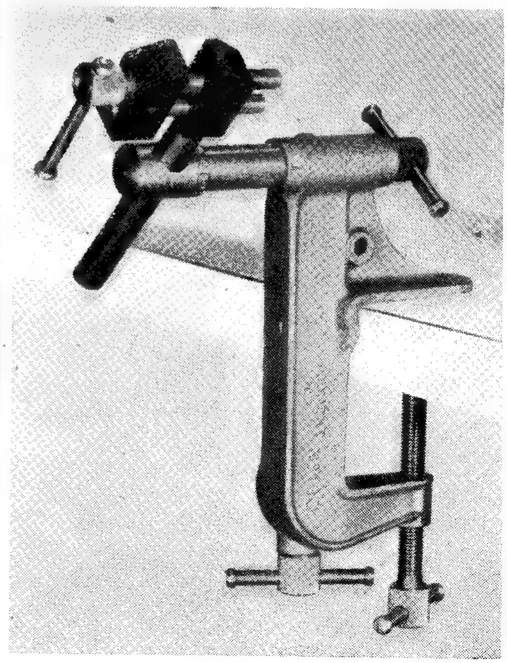


Fig. 2. The "Eclipse" vice to show method of setting at an angle

V-groove is machined across the face of the standing jaw to allow round material to be gripped securely.

This little tool is very well made. Attention has been paid to small points, and it is quite refreshing to find that the manufacturers have

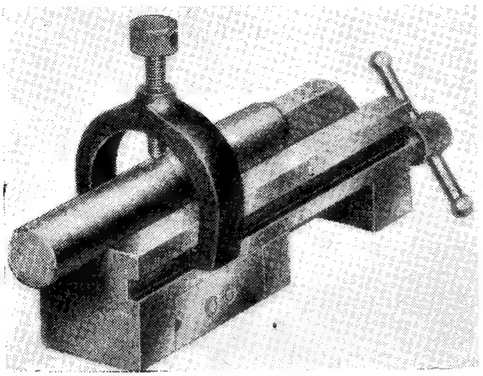


Fig. 3. The "Eclipse" vee-vice in use as a V-block

considered it worth while to incorporate a light spring under each of the cross-handles to ensure that they do remain where the user puts them. This is a small refinement, which calls for praise, for all will agree that cross handles can be an unmitigated nuisance if able to move of their own volition.

It will be observed that a hole some 7/32 in. diameter is drilled horizontally in the upper web of the G-cramp. The manufacturers tell us that they have found this hole is being used for several purposes such as the location of a gauge to act as an aid when positioning components in instrument work. This hole is also, it appears, being employed to house a tensioning fixture when anglers use the vice for fly-tying.

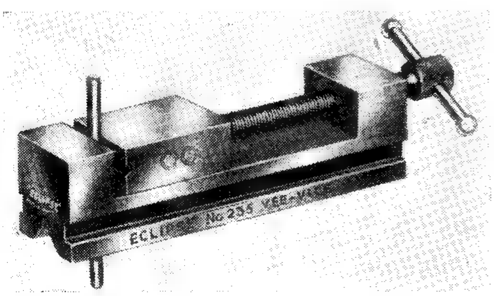


Fig. 4. The vee-vice in use, holding small rod on end

We, ourselves, have used this vice repeatedly for operations which would have, otherwise, been most troublesome to perform and can unhesitatingly recommend it as a most versatile and practical piece of equipment.

The "Eclipse" Vee-Vice. No. 235

The "Eclipse" Vee-Vice is a combination of two separate tools, a V-block and a small machine vice. To this end the device is ground parallel on its upper and lower surfaces so that it may be reversed. When used as a V-block,

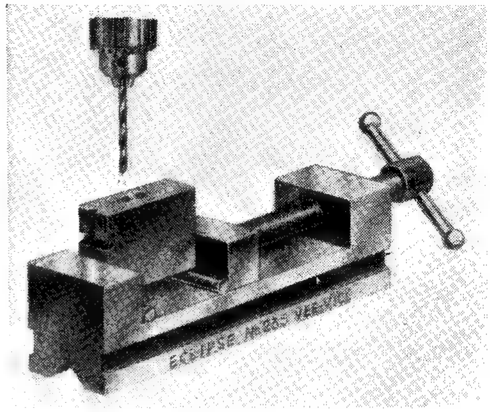


Fig. 5. Work mounted on the cylindrical parallels for drilling

a clamp, fitting into slots machined in the sides of the vice, is used to secure the work. The arrangement is shown in Fig. 3. The maximum diameter of bar which can be accommodated is 1 in., and, as the length of the base is 5 in., a stable mounting for long work is provided. In order to permit a clear passage for a drill, a hole, $\frac{5}{16}$ in. diameter, is machined in the V-groove $\frac{3}{4}$ in. from one end. This hole also allows small cylindrical work to be held vertically, as illustrated in Fig. 4, which shows the device in use as a small machine vice. As will be seen, in addition to the small moving jaw, a second and longer jaw is provided, both being interchangeable. Two small V-grooves, at right-angles to one another, are machined across the face of the

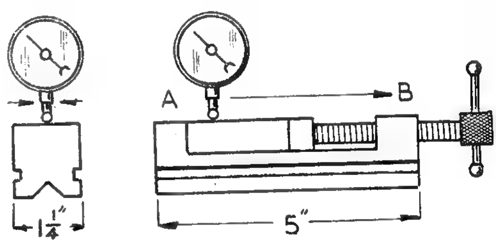


Fig. 6

long jaw, which also houses a pair of cylindrical ground parallels to be inserted under work so as to allow a drill to break through without coming into contact with the vice itself.

To illustrate this, the long jaw has been turned on its side, as seen in Fig. 5, and mounted on the parallels to simulate work being held in this manner for drilling.

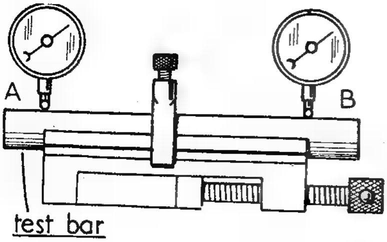


Fig. 7

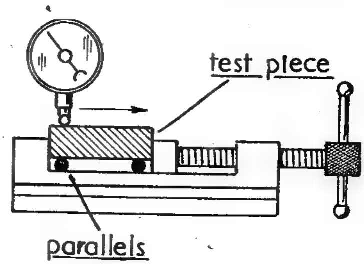


Fig. [redacted]

A machine vice is of little use if it will not accommodate work accurately. Accordingly, tests [redacted] made to assess the worth of the Vee-Vice in this respect.

In the first place the parallelism of the two ground surfaces was tested by placing the vice on [redacted] surface plate upon which a dial test indicator had been mounted, and passing the vice under the indicator, noting any variations in the reading [redacted] the indicator pin passed across and down the surfaces from *A* to *B*, [redacted] illustrated in Fig. 6. This test gave the following result:

Indicator reading at *A* 0.0000 in.
Indicator reading at *B* 0.00025 in.

An error of 0.00025 in. in 5 in., which is well within acceptable limits.

The next test undertaken was designed to show inaccuracy present when the device was used [redacted] V-block. A ground cylindrical parallel test bar was placed in the V-groove and held

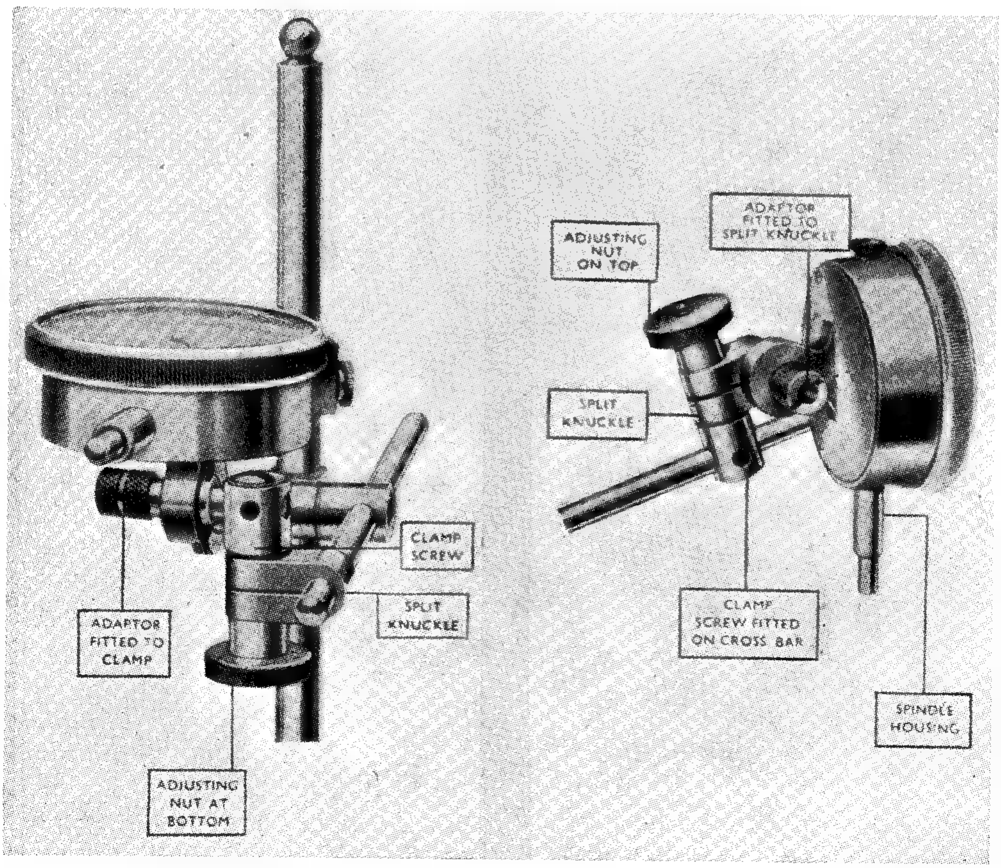


Fig. 9. Methods of mounting dial gauges, using the special adaptor

down by the clamp. The vice was then again placed on the surface plate and the test bar passed under the indicator, as shown diagrammatically in Fig. 7.

Readings were taken at each end of the test bar and the following results obtained :

Indicator reading at A 0.0000 in.

Indicator reading at B 0.0000 in.

No perceptible error recorded.

In order to test the accuracy of the vice when holding work set up on the cylindrical parallels provided, the larger of the two moving jaws was used as a test-piece. This was first placed on the surface plate and checked with the dial test indicator in the manner used when making the test illustrated in Fig. 6. A total error of 0.0005 in. was recorded.

The test-piece was then held in the vice itself, set up on the parallels, as shown diagrammatically in Fig. 8, and further readings taken over the surface. At no point did the error recorded exceed 0.001 in.

From the results of these tests it will be seen that this vice is a high grade piece of equipment, possessing a degree of accuracy in excess of that which is normally acceptable, and there is no reason to suppose that this accuracy will not be maintained, always provided, of course, that the tool receives proper care.

In passing, it should be noted that it is advisable to stone lightly all corners and edges of the vice as, after surface grinding, small burrs tend to be left. These will mark the surface of any machine table or surface plate if not removed before the tool is put into use.

The "Eclipse" Magnetic Base. No. 180

The "Eclipse" Magnetic base has been designed to hold any standard dial test indicator. It is provided with a vertical column $\frac{3}{8}$ in. diameter, to which is attached a clamp carrying an arm for the indicator mounting. The mounting consists of a split knuckle with clamp-screw and adjusting nut, into which is fitted a shouldered and threaded pin having a coned knurl-nut which serves as an adaptor for the dial indicator.

Slackening of either clamp allows the indicator to be adjusted in relation to the work, and the position of the various parts is illustrated in Fig. 9, where an indicator is shown mounted both horizontally and vertically.

As will be seen from the illustration, Fig. 10, the base of the device is of box-form construction, and consists of two iron pole-pieces separated by a brass strip. The permanent magnetic element is built into this box, and is provided with a short-circuiting device which enables the base to be attached or removed at will. This device is controlled by the sliding knob which may be seen in the centre of the front panel of the base.

The device may be affixed either by its under surface or by its sides. In addition, a V-groove is formed in the upper surface of the base member to allow the base to be attached to round components such as shafts or machine-tool spindles.

We have had one of these Magnetic Bases in use for some time now, and can, therefore, speak of its versatility from practical experience. Apart from the ease with which it can be brought into use, the device takes up very little room about a machine, and we have yet to find a situation when it was not possible to use this method of mounting a dial test indicator.

Rigidity

The magnetic base holds the dial indicator with complete rigidity, and is not easily moved,

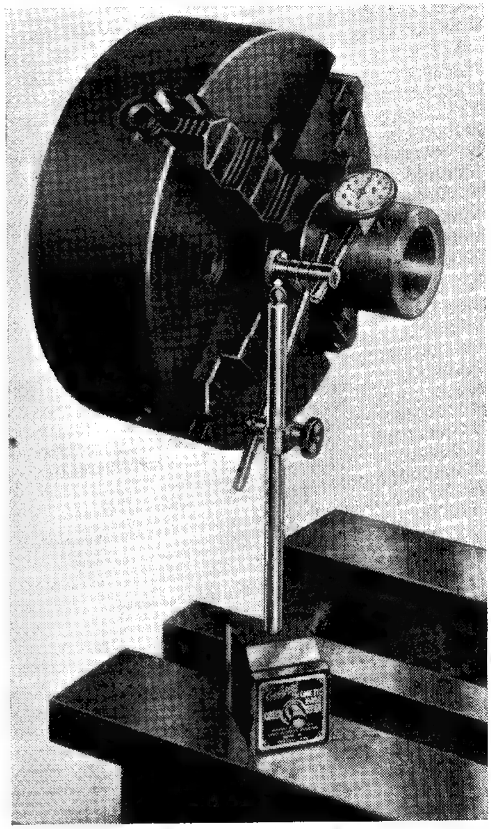


Fig. 10. The "Eclipse" magnetic base

when once set in place, as are the bases of the more common forms of test indicator equipment which rely upon gravity to keep them in position.

The makers supply the magnetic base in a neat wooden box, but we have found it more convenient, for the equipment is in constant use, to provide a piece of $\frac{1}{4}$-in. mild-steel some 3 in. square upon which the base is mounted when not on the surface plate or upon a machine. It can then be left standing on the bench with safety or be put away in the tool cupboard without sustaining damage.

An Experimental Steam Turbine Plant

A chronicle of many endeavours and trials in the quest for high r.p.m.

by D. H. Chaddock

ON account of its capabilities for speed and power in relation to size, let alone noise, the high-speed petrol engine has always been my favourite. During the late war, rumours were current of newer machines which breathed even vaster quantities of fire and flame. Finally, Air Commodore Whittle, now Sir Frank, gave his memorable lecture on the early history of the Whittle jet propulsion gas turbine to the Institution of Mechanical Engineers.

I listened to this lecture twice, once in London and once in Birmingham which I visited for no other purpose. In common, I feel with most of the audience on each occasion I experienced that rarest of all experiences, listening to a pioneer in person telling of his humble beginnings, early failures and disappointments and final triumphant success. The lecture is now a classic, but to all model engineers who are not content to follow the words and music, and whether they be interested in gas turbines or not, I would say get the paper and read it.

And so the challenge was born, could the thing be done in model form: and at this stage all further work on a 15 c.c. V.8 petrol engine was put on one side in favour of the new love—gas turbines.

The first stage was to find out more about the big ones. At first, official information was scarce but soon followed a flood of magazine articles, technical papers and whatnot. I acquired them all, read and digested what I could to the limits of my mental capacity. On the design side there certainly seemed to be enough to make a start; but what about the practical difficulties?

To reduce the matter to its simplest form, suppose an exact 1/20th scale model of a De Havilland "Goblin" engine could be made (which it could not) and that it would work with exactly the same efficiency as the big one (which it would not). How would it look and what would it do? Well the compressor rotor would be about $1\frac{9}{16}$ in. diameter and the turbine wheel about $1\frac{5}{16}$ in. diameter. It would have to run at about 240,000 r.p.m. and the starting speed would be about 30,000 r.p.m. It would burn about 1 gallon of fuel per hour and the turbine would exert about 10 h.p. in driving the compressor. If made, as we have supposed, exactly to scale the power unit would weigh about $2\frac{1}{2}$ lb. and exert a jet thrust of some 5 lb. Alternatively if the energy of the jet were to be expended in another power turbine some further 10 h.p. of mechanical power would be available.

Clearly such a piece of machinery would put all present and future model petrol engines in the shade if only it could be made and if only it would work like that. Those "ifs," if only there was no such word!

However, looking at the proposition through the rosiest pair of spectacles available there seemed to be two main stumbling blocks to be overcome. First to get used to rotating little bits of metal really fast, hundreds of thousands of revolutions per minute, compared with which the best petrol engines doing 10 or 20,000 r.p.m. would not do for starting up. Secondly to find some way of containing a flame equivalent to a 5-pint blow lamp going flat out into the space occupied by a condensed milk tin and keeping it alight and burning efficiently in a howling gale of compressed air.

It was decided to tackle these problems *seriatim*, doing the first one first and going on to the second one when and if the first had been solved.

Now a good deal has been written in past issues of THE MODEL ENGINEER about model steam turbines and all are agreed that to be really efficient they must run very fast indeed. Having made this weighty announcement most writers on the subject then devote the rest of their space to methods of avoiding having to run model turbines fast, large diameter wheels, low steam pressure, multiple stages and so on. With two most honourable exceptions it appears to have occurred to nobody that since, on their own showing, speed is necessary for efficiency, speed is the thing to go for and not to attempt to avoid if a model steam turbine is to become more than a steam-wasting toy. The two exceptions to whom I refer, and in advance I apologise to any others there may be about whom I do not know, are Mr. W. Elkin and Mr. D. C. Gerrard. Both of these gentlemen have made small steam turbines which have exceeded the 100,000 r.p.m. mark and what is more important still they have made accurate tests of steam consumption and power output. Some of Mr. Elkin's work has already been described in THE MODEL ENGINEER and in the Journal of the Society of Model and Experimental Engineers, but in both cases it has been shown by carefully conducted tests that the turbines give just as much power as and use no more steam than a reasonably efficient high speed reciprocating steam engine working under the same conditions of pressure and temperature. Of course, this is not to say that either turbine or reciprocating engine reaches the standard of performance of its full-size counterpart because it does not, but it is of more value than com-

paring a model turbine running on low pressure saturated steam, and not much of that either, with a full-sized car steam engine working at high pressure and superheat.

As far as I am concerned the matter was settled when at the Jubilee Exhibition of the Society of Model and Experimental Engineers held in 1948 I had the honour of being present power output being undiminished, gave the best reciprocator the Stationary Engine Committee had tested a sound beating.

A Flash Steam Turbine

And so the stage was set for the first act. A small steam turbine had been run at over 100,000 r.p.m. Its efficiency, not inferior to a recipro-

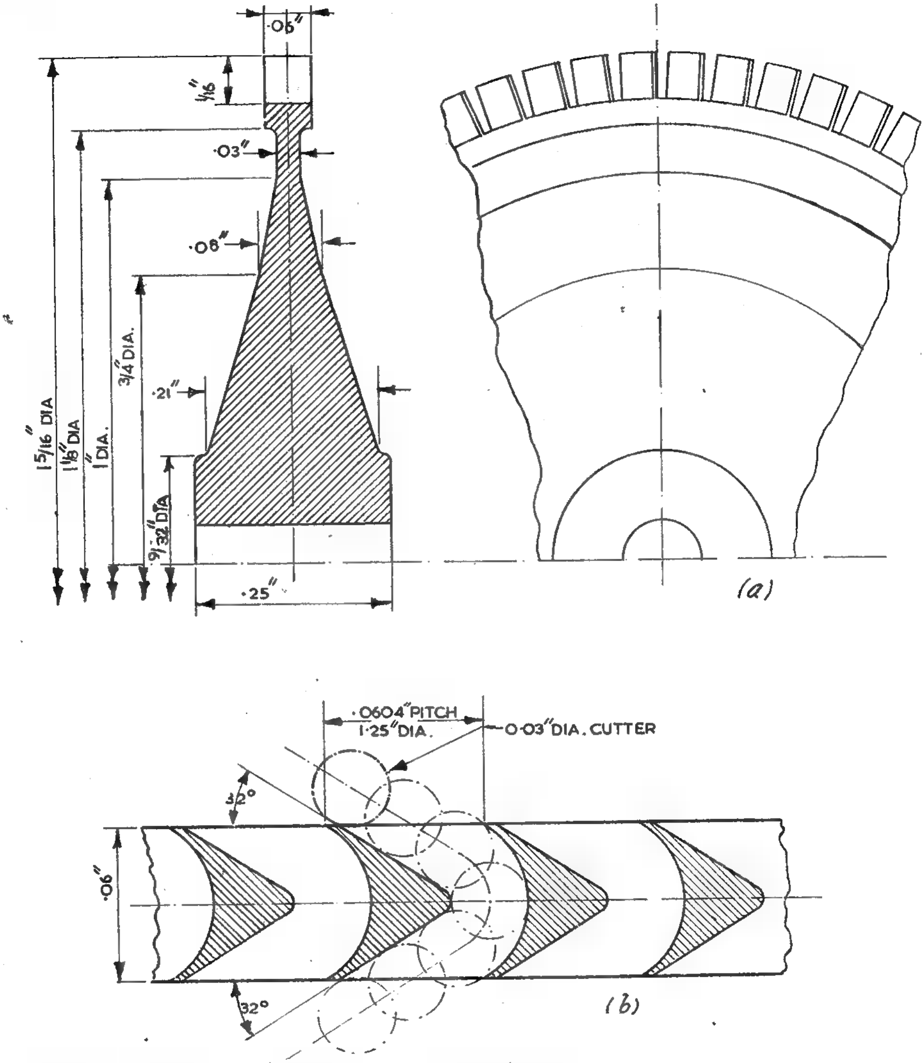


Fig. 1. Design of a high-speed impulse turbine wheel. (a) cross section; (b) method of generating blades

when Mr. Elkin demonstrated his model turbine to H.R.H. the Duke of Edinburgh. Perhaps in honour of the Royal visitor on that occasion the boiler room staff on the Society's Yarrow boiler gave us drier steam at higher pressure than we had ever had before and it worked miracles on the turbine's performance. Instead of using more steam it used considerably less and, the cating engine of the same size had been markedly improved by higher pressure and drier steam. *Ergo* use even higher pressure and a cracking superheat from a flash boiler with a turbine wheel that would be suitable for a gas job so that experience could be gained on high speeds, powers and temperatures.

Now oddly enough, Mr. Elkin's turbine wheel

was just about the size I have mentioned for a 1/20th scale "Goblin" engine, that is $1\frac{5}{16}$ in. outside diameter, although being designed for an impulse steam turbine of the de Laval type the blade shape was very different, as it should be, from that used in the full-sized gas turbine. I decided, therefore, to copy it in form but not in material. The original was cut from a solid disc of brass, which, whilst quite satisfactory for saturated steam and the speeds at which it had run, was hardly the thing to use with red-hot flash steam. In my petrol engine days I had collected a large exhaust valve stamping in excellent heat resisting steel of great strength at high temperature. It was, in fact, Jessops G2, an alloy which has been used in full-size gas turbine work and contains high percentages of nickel and chromium as well as carbon, silicon and tungsten. That, I felt, was just the very thing for my turbine; it would be practically indestructible by heat and speed, as well as being practically unmachinable, perhaps, in the very tricky operations on which I proposed to embark.

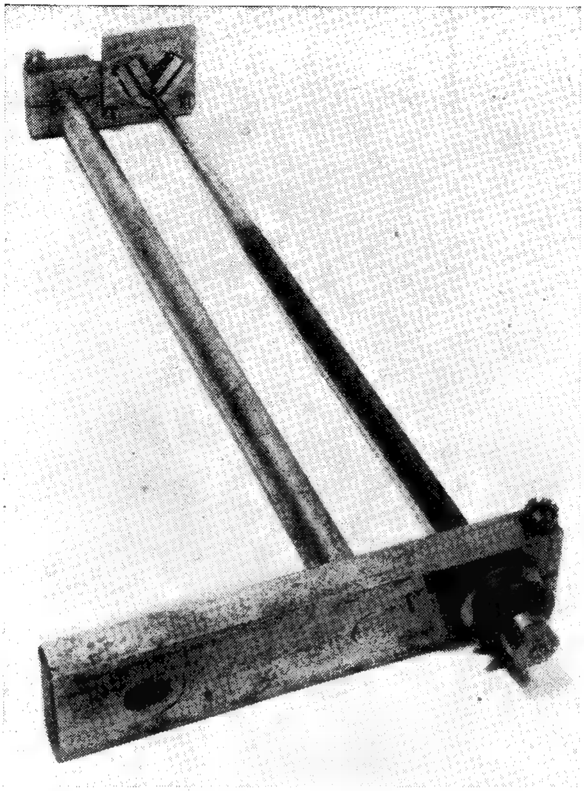


Fig. 2. A copying attachment for the lathe, used for shaping the turbine blades

The Turbine Wheel

The next thing was to get out a suitable design of turbine wheel. Now I intended or at least hoped to run my wheel at the same peripheral velocity as the full-size one, that is 1,400 ft. per sec., that is close upon 1,000 miles per hr. and a good deal more than the much talked of sonic speed. Now it is an unfortunate fact that if one does this the stresses in the wheel do not depend on its size, but only on the tip speed. In other words the tons per sq. in. tending to burst the wheel would be the same as in the big job and not to be treated light-heartedly. Furthermore the strength of a disc rotating at very high speed is very much reduced if a hole of any sort is bored through the middle and for this reason, nearly all full-size gas turbines have solid wheels, either forged in one piece with their drive shafts, or bolted to them by means of short studs engaging in an extended boss. Either of these methods seemed unduly fiddly when reduced to model size and I decided therefore on the design shown in Fig. 1 of a wheel with an extra thick hub (*a*) to compensate in some measure for the loss of strength due to the centre hole and the initial bursting stress due to pressing it a force fit on its shaft.

Design of the Blades

Blading was the next consideration and although I had, and still have, aspirations in the direction of high efficiency airfoil sections, I decided in the first instance to follow Mr. Elkin's example of cutting from the solid relatively simple impulse blading designed round the arc of circle and two tangents as shown in Fig. 1 (*b*). By studying this diagram it will be seen how one pass by a circular end-mill generates the back of one blade and the front of the next, the only requirement being to move the cutter along the prescribed centre line. With a regular engraving machine fitted with a pantograph attachment this would of course have been a perfectly simple process; but, unfortunately such a piece of equipment is not included in my workshop kit. As I have a rooted objection to putting jobs of this sort "out" the next thing was to consider fitting that maid of all work, the lathe with a pantograph. After some thought it was realised that as the total movement of the cutter in completing one blade was so small something less complicated than the parallelogram linkage of a regular pantograph would do the trick with only a slight loss in theoretical accuracy.

A Profiling Attachment for the Lathe

The apparatus shown in the photograph, Fig. 2, has the merit that it only has one moving part, the spindle, and one bearing, a standard self-aligning type ball race and although the appearance is rough, not having been brought to a high finish by scraping the flat surfaces or polishing the round parts it is capable of accurately producing intricate shapes in very tough metal

indeed. The principle of operation will perhaps be rendered clearer by reference to the [redacted] sectional elevation of the spindle part shown in Fig. 3. By making the extended tapering part of the spindle, measured from the centre of the self-aligning ball-race, ten times as long [redacted] the distance measured from the same centre to the point of the cutter, it follows that whatever motion is given to the tracing point is reproduced exactly 1/10th the full size by the cutter, the self-aligning ball-race allowing movement in all directions.

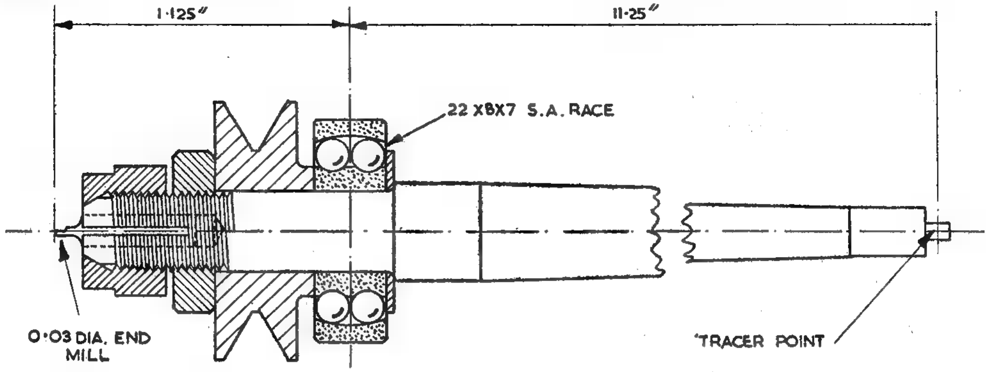


Fig. 3. The spindle of the copying attachment, showing the use of a single self-aligning ball-race

In use the apparatus is clamped on to the lathe top-slide toolpost by the extended section of the rectangular bar with the axis of the spindle at the same height as, but at right-angles to the axis of the lathe centres. The small pulley on the spindle is driven by means of [redacted] light round belt from [redacted] overhead countershaft and although it suffers from some obliquity as the cutter passes through the cut, it is so near to the centre of the movement that there is never any danger of unshipping the belt. The tracing point is guided [redacted] its path cut in [redacted] brass template merely by applying the fingers to the rotating shaft, and although I had some doubts [redacted] to this method before trying it, in practice it proved exceedingly sensitive and the pressure of the cut on a 1/32 in. diameter end mill could be plainly felt, [redacted] feat that would have been impossible with more forceful and positive means of feeding.

The cutters were ground up *in situ* from short pieces of ⅛ in. diameter high speed steel against a small carborundum wheel running on dead centres in the lathe. First the diameter of the stock [redacted] reduced to 0.030 in. diameter and circular for [redacted] length of 0.060 in., rotating the spindle with the fingers with the tracer end parked in [redacted] hole visible in the template. Then with the spindle clamped against rotation [redacted] flat was put on to reduce the section to [redacted] "D" and then [redacted] backed off, using the reducing motion of the spindle to get sufficient control. Finally the oblique cutting edge was formed freehand by the use of [redacted] small stone and a powerful glass.

Plenty of practise [redacted] acquired in this cutter-making ritual and [redacted] surprising amount of good high speed steel reduced to grinding dust because, although experiments on a brass blank showed that the system worked all right, when the real blank, which had previously been turned to shape, was mounted [redacted] true running mandrel held in the lathe chuck and indexed by means of [redacted] 65-tooth change wheel the nickel chrome tungsten alloy showed its true mettle. Although the tiny end mill would wade through it in fine style when freshly ground and quite sharp, it soon lost its cutting edge and any attempt to force the cut resulted in disaster. Finally bitter experience taught that two blades, cut to full depth was all that could be counted upon for one sharpening, after which it paid to break down the whole set-up, regrind the cutter and begin again.

I think it took about [redacted] fortnight to produce all the blades on the wheel and although I regretted the choice of such [redacted] intractable material at the time, I have since had cause to be glad, in that in all the disasters the plant has encountered the wheel, with its fragile-looking blades, has emerged unscathed.

Design of the Nozzles

After the wheel the nozzles are the most important part in an impulse steam turbine. Data on the working pressures and temperatures of existing flash steam plants are so scarce as to be practically non-existent, so I decided on a good guess and took 500 lb. per sq. in. pressure and [redacted] superheat of 200 deg. F. [redacted] the probable working conditions. The total steam temperature would be 668 deg. F., that is something just above the melting point of lead.

The flash boiler which it was proposed to use, to be mentioned in due course later on, was thought to be capable of evaporating 4 oz. of water per minute under these conditions. With this data it is only [redacted] matter of calculation, which can be found in any standard text book on heat engines, to work out the correct sizes and proportions of the nozzles. It came out that two nozzles each 0.020 in. diameter at the throat and expanding to 0.050 in. at the outlet would pass this amount of steam at the stipulated pressure and temperature. The steam speed would be 3,600 ft. per second at the outlet and after expansion down to atmospheric pressure, where it would have lost all its superheat and become slightly wet.

(*To be continued*)

Novices' Corner

Using Calipers

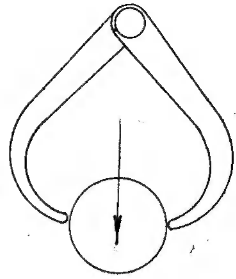


Fig. 1. The outside calipers just fall with their own weight

UNLIKE the heavy gauges used in factories for checking machined work, the ordinary inside and outside calipers can, when making measurements, quite easily be sprung over the work by applying very little additional force. With practice, however, the sense of touch becomes more sensitive and very small variations in the size of work-pieces can then be distinctly felt.

Inside and Outside Calipers

The amount of force used to pass the calipers over the work depends on the operator's sense of touch and so is liable to vary in different circumstances. This difficulty can often be overcome by merely supporting the calipers with the tips of the fingers and allowing the force of gravity alone to move the calipers over the part being measured. In Fig. 1 the outside calipers are shown gauging the diameter of a shaft; the joint portion, or the bow of spring calipers, is lightly held and, with the two elbows resting on the bench, the tool is adjusted until it will just fall by its own weight. A second shaft, which is being machined to the exact diameter of the first, is then tested in the same way and the machining is continued until the calipers again will just fall.

The same method can be used with the inside calipers, as shown in Fig. 2, when, for example, machining or filing a slot to the exact width of another slot. The following test, as represented in Fig. 3, was made to test the accuracy of this method: the legs of a pair of inside calipers were set approximately $\frac{3}{4}$ in. apart and were then applied to the jaws of a micrometer; the micrometer was adjusted so that the calipers would just fall by their own weight and the reading was noted; next, the micrometer was closed by $\frac{1}{4}$-thousandth of an inch, and it was then found that the calipers would no longer fall. Again, when the micrometer was set $\frac{1}{2}$-thousandth of an inch closer than the initial setting, quite appreciable force was required to pass the calipers through the jaws. When testing the diameter of a bore machined in a part held in the lathe chuck, this method cannot, of course, be used. Here, the measuring operation will be made easier if the contact points of the calipers are held vertically, one above the other. Then, with the lower point resting against the bore, the adjustment is made while the joint end of the calipers is raised and lowered, and also turned from side to side, to ensure that the upper jaw is likewise making light contact.

This, then, is one way of making two or more parts of exactly the same size, that is to say to within the limits commonly used in machining. When a part has to be made to a given dimension, the outside calipers can be set from a rule in the manner shown in Fig. 4. As the position of the free leg of the calipers in relation to the rule

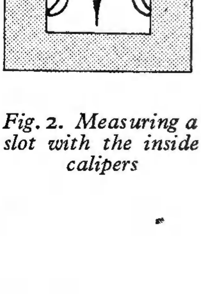


Fig. 2. Measuring a slot with the inside calipers

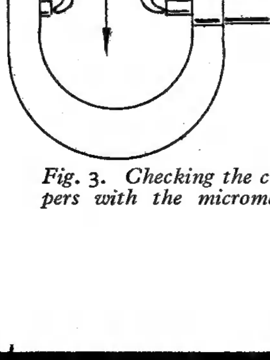


Fig. 3. Checking the calipers with the micrometer

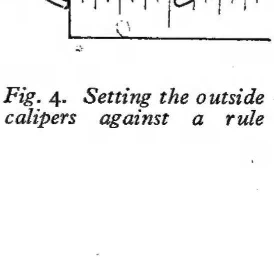


Fig. 4. Setting the outside calipers against a rule

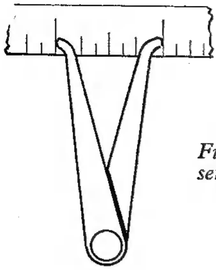


Fig. 5. Method of setting the inside calipers

graduations must be estimated by eye, an error is easily made ; in addition, if the end of the rule has become worn by misuse, a further error is introduced.

As illustrated in Fig. 5, the inside calipers should be set from two graduations well away from the end of the rule.

To obtain a more accurate adjustment of the calipers, they can be set from the jaws of a micrometer or from a gauge of known size. Fig. 6. shows the calipers being set in this way and then applied vertically to the bore of a workpiece. In such a case, it is, however, more usual to apply the calipers to the bore and then to measure the setting with the micrometer, so that the bore size can be corrected exactly by further machining.

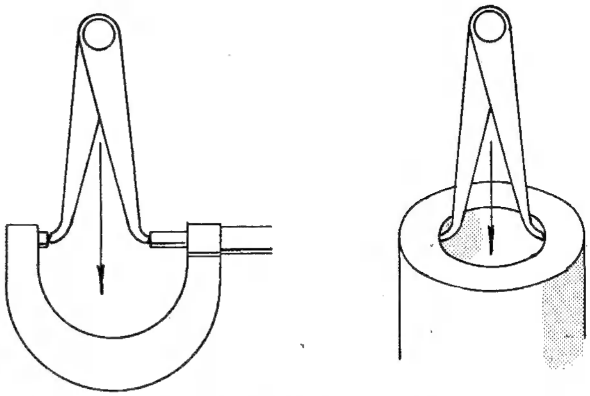


Fig. 6. *Left—setting the calipers with the micrometer ; Right—checking a bore diameter*

It may happen that a micrometer is not available, and a shaft has to be turned to fit a bush using calipers alone. This work will usually be facilitated if the bush is first bored to size and the shaft is then turned to fit. Set the inside calipers to the finished bore, as shown in Fig. 6, and then adjust the outside calipers so that they just fall when both are held vertically, as represented in Fig. 7. The outside calipers now form the gauge for sizing the shaft to fit accurately in the bore of the bush, and it will then only remain to reduce the diameter of the shaft by a small amount to provide the necessary working clearance. When fitting shafts in this way, it is best to preserve the gauge setting of the outside calipers and to use another pair to test the progress of the work.

Another method of transferring the setting of the inside calipers to the outside calipers is to mate the four contact points while resting on a flat piece of material, as shown in Fig. 8. The accuracy of the setting will then depend on the operator's sense of touch.

Thread Calipers

The easiest way, of course, to measure the outside diameter of a screw thread is to use a micrometer, but if thread calipers, having legs with expanded tips, are employed, comparison with a thread of known accuracy can readily be made.

The two forms of thread calipers illustrated in the previous article are used for measuring the core diameter of a thread ; this dimension can either be obtained from a set of tables or measured against a thread of known size. A direct measurement is better for comparison, as owing to the spiral form of the thread, any measurement across the roots of two opposite threads will be made obliquely to the thread axis and will not correspond with the theoretical value.

The internal thread calipers are difficult to use, as the sharp, needle points will not slide smoothly in the work. Insert the caliper points

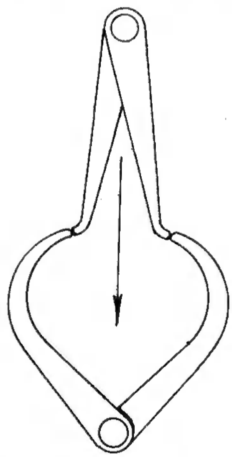


Fig. 7. *Transferring a setting to the outside calipers held vertically*

in the threaded bore, and turn the adjustment screw until the calipers can be rotated freely but without shake ; the calipers are then withdrawn with an unscrewing motion so that the points travel along the path of the thread.

A measurement can then be taken across the tips with a micrometer or, preferably, a trial is made on a thread of standard dimensions.

Dividers

The dividers are set by engaging the two points simultaneously in two rule graduations ; if one point is held firmly in a graduation line while the adjustment screw is turned, the other point can usually be felt to enter the second mark on the rule.

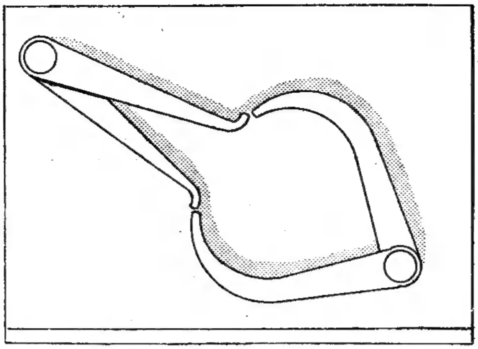


Fig. 8. Using a flat surface when making a transfer setting

When laying off dimensions or scribing circles with the dividers, one leg should be located in a very shallow mark made with a fine centre punch, for if this is not done the first leg may easily slip and the second leg will then make a false mark. Again, if a deep punch mark is used for positioning the leg, an error will be introduced when setting off a short distance, for the two points will not then lie parallel with the work surface.

A Small Bench Grinder

by G. A. Gaunt

THE small bench grinder shown in the drawing was made up recently to be used in conjunction with a twist drill grinding jig.

The entire machine is made from scrap material including two $\frac{5}{8}$-in. ball-races from an old car dynamo. The base was turned from solid steel, drilled and tapped $\frac{1}{2}$ in. B.S.F., and drilled $\frac{3}{8}$ in. on $2\frac{1}{2}$ in. diameter for two holding-down bolts.

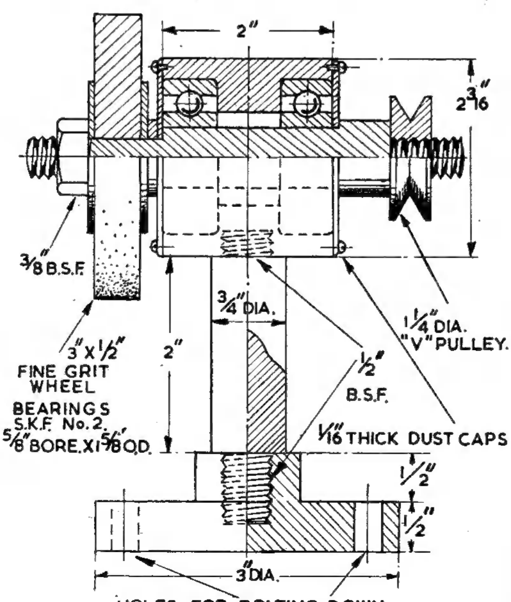
A mild-steel column to support the head was turned and screwcut each end $\frac{1}{2}$ in. B.S.F. to screw into the base and head.

The only part calling for extra care in making is the head of the machine to ensure concentricity of the ball-races. This is made from a piece of mild-steel tube, $2\frac{1}{4}$ in. o.d. × 1 in. bore, and was chucked in the three-jaw, faced, turned all over as far as the chuck jaws would allow, and then honed out to $1\frac{5}{8}$ in. diameter × $\frac{9}{16}$ in. deep for a $\frac{5}{8}$ in. bore ball-race.

The work was then removed from the chuck, and a stub end of mild-steel bar chucked and turned down a tight press fit for the recessed end of the grinding head.

This was pressed on by hand while the bar was still in the chuck, and the o.d. finish turned, the end faced and bored for the other ball-race.

The spindle is quite a straightforward piece of turning as the drawing shows, and, when in position, is locked by the pulley, which is tapped $\frac{3}{8}$ in. B.S.F. to screw on to the spindle.



A tool rest is not described, as the drill-grinding jig screws on to the bench in front of the machine, but it would be quite a simple matter to rig one up.

The caps to prevent entry of grinding dust into the ball-races are turned out of large mild-steel discs and are bored $\frac{5}{8}$ in. to just clear the spindle. They are secured to the head of the machine by $\frac{1}{8}$-in. round-head screws.

This small machine runs quite freely, and, in spite of being cheaper than some commercial ones, should last well, running on races.

PRACTICAL LETTERS

Rust Prevention

DEAR SIR,—I am glad that so much space has been given recently to this question of rust. How many thousands of pounds' worth of tools must be ruined each year from this cause?

To add my quota to the suggestions made: I have recently fitted a thermostat which really does keep the workshop at an even temperature; and this is probably the most important point. When the thermostat is on, it brings into circuit a neon lamp, and I am quite sure that the cost of a thermostat will be saved by the current saving over a period of some time. Whereas I used to leave the current on all the time, I now find that the thermostat at this time of the year, only brings the heater on about one-third of the time.

In addition to this, I have lined the roof with "Alfol." This is a heavy paper covered on both sides with what appears to be a thin aluminium foil, and I have been absolutely astonished at the difference that this has made. The material is supplied in roll form and wants fitting with a space between the actual roof boards—in my case this is easily done, it is simply fitted with drawing pins down the rafters. The principle on which it works is obviously that of reflecting heat and this way opposes any change of temperature in the building. Quite apart from its effectiveness as an insulator, it has made a wonderful difference to the amount of light, which is now, of course, reflected from the whole of the roof.

One roll of the material would probably be too much for the average workshop, but two or three friends joining together would find it a most economical proposition from every point of view. It will be obvious, of course, that the workshop is also kept cool in the summer.

I bought my supply direct from the manufacturer, whose address is:—Alfol Insulation Ltd., 68, Victoria St., London, S.W.1, and would finally add that I have no connection in any way whatsoever with this concern.

Yours faithfully,

Leicester. R. S. FARMER.

Lathe Apron for 3½ in. Drummond

DEAR SIR,—Your correspondent Mr. T. R. Franks of Deal, THE MODEL ENGINEER, November 2nd, refers to the article on an apron for the 3½-in. Drummond lathe which appeared in Vol. 89, and quite rightly points out an error in in one of the dimensions of the T-piece. As he says, this should have been shown as $\frac{7}{16}$ in. and not $\frac{7}{8}$ in., and I am sorry if it has caused him some inconvenience. So far as I know, this is the only error in the drawings, and it may reassure Mr. Franks to hear that I know personally of at least half a dozen of these aprons which are working satisfactorily—one, incidentally by your S. African correspondent Mr. Spence, a letter from whom appears in THE MODEL ENGINEER for October 26th, 1950.

Regarding the separation of the split-nut, Mr. Franks will see, if he reads the article, that at the bottom of p. 89 it is pointed out that the flanks of the threads, are intended to be relieved in the way he suggests. This is quite normal practice, and he will find that he will get disengagement without any re-designing, if he provides this relief.

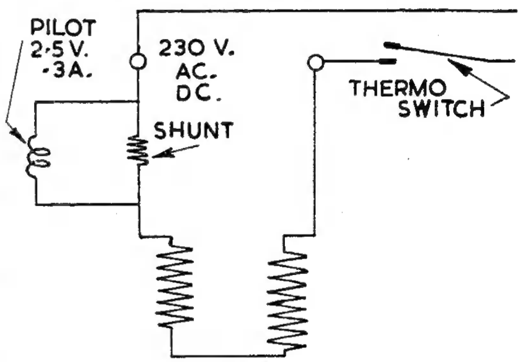
I wish Mr. Franks all success, and I should be very glad to show him the apron on my lathe should he be in Sheffield at any time.

Yours faithfully,

Sheffield. HARRY LLOYD.

Aquarium Equipment

DEAR SIR,—I was very interested in the article on aquarium equipment in recent issues of THE MODEL ENGINEER. My brother, also a fish-keeper and a keen reader of "ours," tells me that I need a heater, and a thermostat to control my tank temperature. I was at a loss to work out the heater, but the thermostat offered no difficulty, as I had a thermostatic control from an ex-government gun camera. This is ready mounted and has a control, also a mating contact fixed to it, and would do the job nicely.



If other readers have any difficulty in obtaining bimetal strips, the following tip may be useful. Any electrical dealer who undertakes the repair of automatic heat controlled smoothing irons is sure to have replacement strips. These are about 1½ in. long by 3/8 in., tapering to about ¼ in. and usually cost about five pence. If the reader wants one with a contact fitted to the end, he should ask for an old Easipower element as they are attached in this type, and are supplied new with a new element.

If an indicator light is required, the accompanying circuit can be used. The resistance is a few ohms and can be cut from an old electric fire spiral, about six turns from a 1 kW element, but this really depends on the wattage of the heater. The more resistance in the shunt, the higher will be the voltage. Shunts for this purpose can again be obtained from the same place as the bimetal at a cost of about three-pence.

Yours faithfully,

Aldeburgh. E. C. WRIGHT.